EN 300 328 V2.2.2 (2019-07)

TEST REPORT

For

Roku, Inc.

1155 Coleman Ave.
San Jose, CA 95110, USA

Model: 3820X with WR002
Similar Model‡: 3820X2, 3821X, 3821X2

Report Type: Revised Report	**Product Type:** Streaming Player
Prepared By:	Rita Yang Test Technician
Report Number:	R2205317-328
Report Date:	2022-09-14
Reviewed By:	Christian McCaig RF Project Engineer

Bay Area Compliance Laboratories Corp.
1274 Anvilwood Avenue,
Sunnyvale, CA 94089, USA
Tel: (408) 732-9162, Fax: (408) 732-9164

CERTIFICATE #3297.02

TABLE OF CONTENTS

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R2106181-328	Original Report	2021-08-26
1	R2205317-328	Revised Report. Added similar models.	2022-09-14

1 General Information

1.1 Product Description for Unit Under Test (UUT)

This test report was prepared on behalf of *Roku, Inc.*, and their product model: *3820X with WR002* or the "EUT" as referred to in this report. The EUT has 2.4GHz/5GHz Wifi capabilities.

The EUT was evaluated as a complete unit, which consist of models 3820X and WR002. In order for the device to function, both sub-devices must be connected to each other (refer to the User Manual for more information) and are always packaged together for the market. Similarity and differences between tested model 3820X and models 3820X2, 3821X, and 3821X2 are described by the Declaration of Similarity provided by the customer (Annex C).

1.2 Mechanical Description of UUT

The UUT measures approximately 9.5 cm (L) x 2.0 cm (W) x 1.2 cm (H) and weighs < 1kg.

1.3 Objective

The following type approved report was prepared on behalf *Roku, Inc.* in accordance with EN 300 328 V2.2.2 (2019-07), Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz ISM band and using wide band modulation techniques; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU

The objective was to determine compliance with EN 300 328 V2.2.2 (2019-07), Electromagnetic compatibility and Radio spectrum Matters (ERM) for Bluetooth and WLAN portion.

In order to determine compliance, the manufacturer or a contracted laboratory makes measurements and takes the necessary steps to ensure that the equipment complies with the appropriate technical standards.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product maybe which result in lowering the immunity should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing and/or I/O cable changes, etc.).

1.4 Test Methodology

All measurements contained in this report were conducted with EN 300 328 V2.2.2(2019-07), Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz ISM band and using wide band modulation techniques; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU

All tests were performed at Bay Area Compliance Laboratories Corp.

1.5 Test Facility Registrations

BACLs test facilities that are used to perform Radiated and Conducted Emissions tests are currently recognized by the Federal Communications Commission as Accredited with NIST Designation Number US1129.

BACL's test facilities that are used to perform Radiated and Conducted Emissions tests are currently registered with Industry Canada under Registration Numbers: 3062A-1, 3062A-2, and 3062A-3.

BACL is a Chinese Taipei Bureau of Standards Metrology and Inspection (BSMI) validated Conformity Assessment Body (CAB), under Appendix B, Phase I Procedures of the APEC Mutual Recognition Arrangement (MRA). BACL's BSMI Lab Code Number is: SL2-IN-E-1002R

BACL's test facilities that are used to perform AC Line Conducted Emissions, Telecommunications Line Conducted Emissions, Radiated Emissions from 30 MHz to 1 GHz, and Radiated Emissions from 1 GHz to 6 GHz are currently recognized as Accredited in accordance with the Voluntary Control Council for Interference [VCCI] Article 15 procedures under Registration Number A-0027.

1.6 Test Facility Accreditations

Bay Area Compliance Laboratories Corp. (BACL) is:

A- ***An independent, 3rd-Party, Commercial Test Laboratory accredited to ISO/IEC 17025:2017 by A2LA (Test Laboratory Accreditation Certificate Number 3297.02),*** in the fields of: Electromagnetic Compatibility and Telecommunications. Unless noted by an Asterisk (*) in the Compliance Matrix (See Section 3 of this Test Report), BACL's ISO/IEC 17025:2017 Scope of Accreditation includes all of the Test Method Standards and/or the Product Family Standards detailed in this Test Report..

BACL's ISO/IEC 17025:2017 Scope of Accreditation includes a comprehensive suite of EMC Emissions, EMC Immunity, Radio, RF Exposure, Safety and wireline Telecommunications test methods applicable to a wide range of product categories. These product categories include Central Office Telecommunications Equipment [including NEBS - Network Equipment Building Systems], Unlicensed and Licensed Wireless and RF devices, Information Technology Equipment (ITE); Telecommunications Terminal Equipment (TTE); Medical Electrical Equipment; Industrial, Scientific and Medical Test Equipment; Professional Audio and Video Equipment; Industrial and Scientific Instruments and Laboratory Apparatus; Cable Distribution Systems, and Energy Efficient Lighting.

B- ***A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3297.03)*** to certify

- For the USA (Federal Communications Commission):
  1- All Unlicensed radio frequency devices within FCC Scopes A1, A2, A3, and A4;
  2- All Licensed radio frequency devices within FCC Scopes B1, B2, B3, and B4;
  3- All Telephone Terminal Equipment within FCC Scope C.
- For the Canada (Industry Canada):
  1 All Scope 1-Licence-Exempt Radio Frequency Devices;
  2 All Scope 2-Licensed Personal Mobile Radio Services;
  3 All Scope 3-Licensed General Mobile & Fixed Radio Services;
  4 All Scope 4-Licensed Maritime & Aviation Radio Services;
  5 All Scope 5-Licensed Fixed Microwave Radio Services
  6 All Broadcasting Technical Standards (BETS) in the Category I Equipment Standards List.
- For Singapore (Info-Communications Development Authority (IDA)):
  1 All Line Terminal Equipment: All Technical Specifications for Line Terminal Equipment – Table 1 of IDA MRA Recognition Scheme: 2011, Annex 2
  2. All Radio-Communication Equipment: All Technical Specifications for Radio-Communication Equipment – Table 2 of IDA MRA Recognition Scheme: 2011, Annex 2

- For the Hong Kong Special Administrative Region:
  1 All Radio Equipment, per KHCA 10XX-series Specifications;
  2 All GMDSS Marine Radio Equipment, per HKCA 12XX-series Specifications;
  3 All Fixed Network Equipment, per HKCA 20XX-series Specifications.
- For Japan:
  1 MIC Telecommunication Business Law (Terminal Equipment):
    - All Scope A1 - Terminal Equipment for the Purpose of Calls;
    - All Scope A2 - Other Terminal Equipment
  2 Radio Law (Radio Equipment):
    - All Scope B1 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 1 of the Radio Law
    - All Scope B2 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 2 of the Radio Law
    - All Scope B3 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 3 of the Radio Law

C- ***A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3297.01)*** to certify Products to USA's Environmental Protection Agency (EPA) ENERGY STAR Product Specifications for:

1 Electronics and Office Equipment:
- for Telephony (ver. 3.0)
- for Audio/Video (ver. 3.0)
- for Battery Charging Systems (ver. 1.1)
- for Set-top Boxes & Cable Boxes (ver. 4.1)
- for Televisions (ver. 6.1)
- for Computers (ver. 6.0)
- for Displays (ver. 6.0)
- for Imaging Equipment (ver. 2.0)
- for Computer Servers (ver. 2.0)

2 Commercial Food Service Equipment
- for Commercial Dishwashers (ver. 2.0)
- for Commercial Ice Machines (ver. 2.0)
- for Commercial Ovens (ver. 2.1)
- for Commercial Refrigerators and Freezers

3 Lighting Products
- For Decorative Light Strings (ver. 1.5)
- For Luminaires (including sub-components) and Lamps (ver. 1.2)
- For Compact Fluorescent Lamps (CFLs) (ver. 4.3)
- For Integral LED Lamps (ver. 1.4)

4 Heating, Ventilation, and AC Products
- for Residential Ceiling Fans (ver. 3.0)
- for Residential Ventilating Fans (ver. 3.2)

5 Other
- For Water Coolers (ver. 3.0)

D- ***A NIST Designated Phase-I and Phase-II Conformity Assessment Body (CAB) for the following economies and regulatory authorities under the terms of the stated MRAs/Treaties:***

- Australia: ACMA (Australian Communication and Media Authority) – APEC Tel MRA -Phase I;
- Canada: (Innovation, Science and Economic development Canada - ISEDC) Foreign Certification Body – FCB – APEC Tel MRA -Phase I & Phase II;
- Chinese Taipei (Republic of China – Taiwan):
  - o BSMI (Bureau of Standards, Metrology and Inspection) APEC Tel MRA -Phase I;
  - o NCC (National Communications Commission) APEC Tel MRA -Phase I;
- European Union:
  - o EMC Directive 2014/30/EU US-EU EMC & Telecom MRA CAB (NB)

  - o Radio Equipment (RE) Directive 2014/53/EU US-EU EMC & Telecom MRA CAB (NB)
  - o Low Voltage Directive (LVD) 2014/35/EU
- Hong Kong Special Administrative Region: (Office of the Telecommunications Authority – OFTA) APEC Tel MRA -Phase I & Phase II
- Israel – US-Israel MRA Phase I
- Republic of Korea (Ministry of Communications - Radio Research Laboratory) APEC Tel MRA -Phase I
- Singapore: (Infocomm Media Development Authority - IMDA) APEC Tel MRA -Phase I & Phase II;
- Japan: VCCI - Voluntary Control Council for Interference US-Japan Telecom Treaty VCCI Side Letter-
- USA:
  - o ENERGY STAR Recognized Test Laboratory – US EPA
  - o Telecommunications Certification Body (TCB) – US FCC;
  - o Nationally Recognized Test Laboratory (NRTL) – US OSHA
- Vietnam: APEC Tel MRA -Phase I;

1.7 Measurement Uncertainties

All measurements involve uncertainties. In the case of unlicensed / licensed wireless/radio transmitters, receivers, and transceivers, the influence quantities (factors) that make a significant contribution to the measurement uncertainties are detailed in the latest version of ETSI TR 100-028 Parts 1 and 2 (i.e., ETSI TR 100-028-1 V1.4.1 (2001-12) “Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 1”, and ETSI TR 100-028-2 V1.4.1 (2001-12) “Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 2”,

Based on the uncertainty models given in the latest versions of ETSI TR 100 028-1 and ETSI TR 100 028-2, and, based on the calibration uncertainties of the specific instruments and facilities used at BACL to perform the measurements documented in this Test Report, the following estimates have been made of BACL’s Measurement Uncertainties for the measurements documented in this Test Report.

Type of Measurement	**BACL Typical U_{LAB} Value** (for a k=2 Coverage Factor, equivalent to ~ 95% level of confidence) [Note: Calculated Values]	**BACL Typical U_{LAB} Value** (for a k=2 Coverage Factor, equivalent to ~ 95% level of confidence) [Note: all U_{LAB} Calculated values have been rounded to the one significant figure to the right of the decimal]
RF Output Power, conducted	± 0.863 dB	± 0.9 dB
Power Spectral Density, conducted	± 0.863 dB	± 0.9 dB
Unwanted Emissions, conducted	± 2.761 dB	±2.8 dB
All emissions, radiated	± 3.186 dB	± 3.2 dB
Temperature	± 0.68 °C	± 0.7 °C
Supply voltages	± 1.5%	± 1.5 %
Time	± 2.42%	± 2.4 %

2 UUT TEST CONFIGURATION

2.1 Justification

The UUT was configured for testing according to EN 300 328 V2.2.2 (2019-07).

2.2 UUT Exercise Software

The test software used was TeraTerm. The software is compliant with the standard requirements being tested against.

Modulation	Frequency (MHz)	Power Setting	
		Ant A	Ant B
802.11b	2412	78	78
	2437	78	78
	2472	73	73
802.11g	2412	66	66
	2437	68	68
	2472	62	62
802.11n20	2412	50	50
	2437	52	52
	2472	48	48
802.11n40	2422	53	53
	2437	55	55
	2462	52	52

Data Rates Tested:
802.11b mode: 1Mbps
802.11g mode: 6Mbps
802.11n HT20 mode: MCS0
802.11n HT40 mode: MCS0

2.3 Equipment Modifications

N/A

2.4 Special Equipment

Manufacturer	Description	Model
Roku, Inc.	Debug Board	-

2.5 Local Support Equipment

Manufacturer	Description	Model
Dell	Laptop	Latitude E7450

2.6 Power Supply and Line Filters

Manufacturer	Description	Model
Roku, Inc.	Switching Adapter	ADS-65CJ-12-2 12060E

2.7 Interface Ports and Cabling

Cable Description	Length (m)	To	From
USB Cable	<1M	Laptop	UUT
RF Cable	<1M	UUT	PSA

3 Summary of Test Results

EN 300 328 V2.2.2	Description Of Tests	Results
Clause 4.3.2.2	RF Output Power	Compliant
Clause 4.3.2.3	Maximum e.i.r.p Spectral Density	Compliant
Clause 4.3.2.4	Duty Cycle	N/A[1]
Clause 4.3.2.5	MU Factor	N/A[1]
Clause 4.3.2.6	Adaptivity	Compliant
Clause 5.4.7.2	Occupied Channel Bandwidth	Compliant
Clause 4.3.2.8	TX Unwanted Emissions in the out of Band Domain	Compliant
Clause 4.3.2.9	TX Unwanted Emissions in the Spurious Domain	Compliant
Clause 4.3.2.10	Receiver Spurious Emissions	Compliant
Clause 4.3.2.11	Receiver Blocking	Compliant
Clause 4.3.2.12	Geo-location capability	Compliant[2]

[1] *UUT is working at adaptive mode only.*
[2] *Manufacturer declared UUT does not have Geo-location capability.*

4 EN 300 328 Clause 5.4.7.2 – Occupied Channel Bandwidth

4.1 Applicable Standard

The Occupied Channel Bandwidth shall fall completely within the band given in clause 1.

In addition, for non-adaptive equipment using wide band modulations other than FHSS and with e.i.r.p greater than 10 dBm, the occupied channel bandwidth shall be less than 20 MHz.

4.2 Measurement Procedure

In case of conducted measurements on smart antenna systems (equipment with multiple transmit chains) measurements need only to be performed on one of the active transmit chains (antenna outputs).

The measurement procedure shall be as follows:

Step 1:
Connect the UUT to the spectrum analyzer and use the following settings:

- Centre Frequency: The centre frequency of the channel under test
- Resolution BW: ~ 1 % of the span without going below 1 %
- Video BW: 3 × RBW
- Frequency Span for frequency hopping equipment: Lowest frequency separation that is used within the hopping sequence
- Frequency Span for other types of equipment: 2 × Nominal Channel Bandwidth (e.g. 40 MHz for a 20 MHz channel)
- Detector Mode: RMS
- Trace Mode: Max Hold
- Sweep time: 1 s

Step 2: Wait for the trace to stabilize.

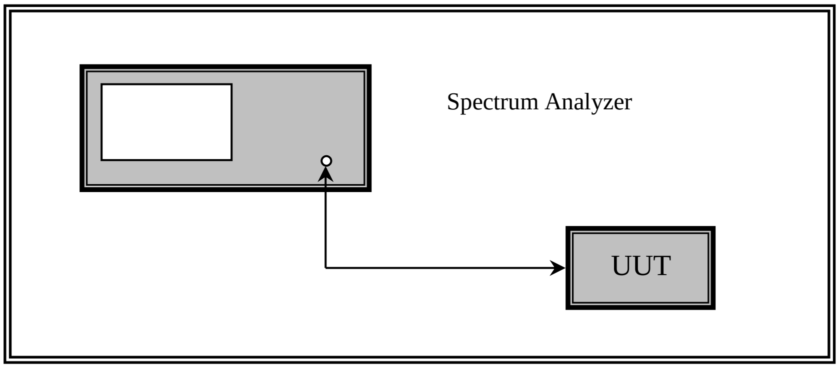
Find the peak value of the trace and place the analyzer marker on this peak.

Step 3:
Use the 99 % bandwidth function of the spectrum analyzer to measure the Occupied Channel Bandwidth of the UUT.

This value shall be recorded.

NOTE: Make sure that the power envelope is sufficiently above the noise floor of the analyzer to avoid the noise signals left and right from the power envelope being taken into account by this measurement.

4.3 Test Setup Block Diagram



4.4 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Rhode&Schwarz	Signal Analyzer	FSV40	101203	2021-04-26	12 Months
-	RF cable	-	-	Each time[1]	N/A
-	20dB attenuator	-	-	Each time[1]	N/A

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".*

4.5 Environmental Conditions

Temperature:	23° C
Relative Humidity:	46 %
ATM Pressure:	101.1 kPa

Testing was performed by Rita Yang on 2021-06-30 on RF site.

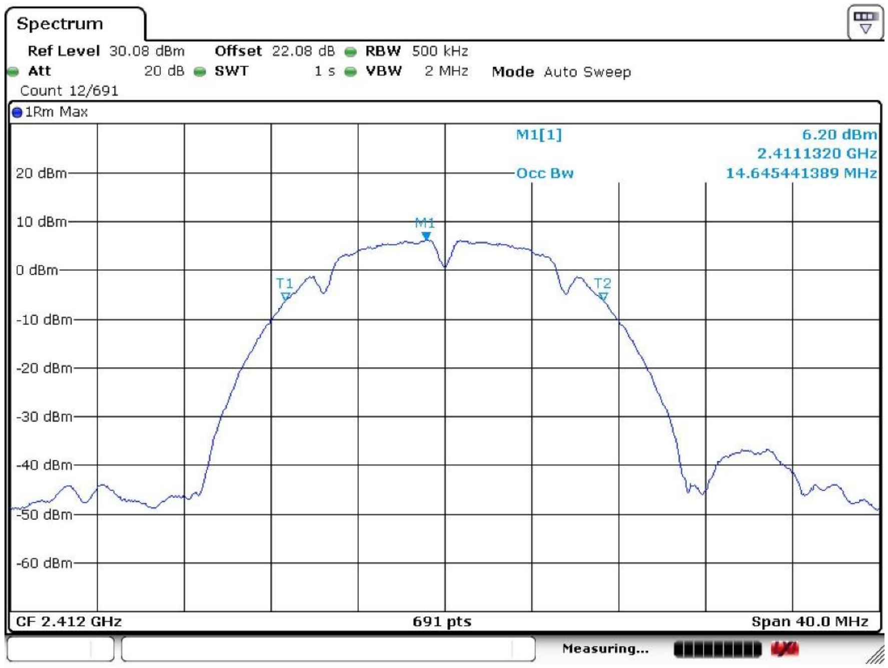
4.6 Test Results

Mode	Frequency (MHz)	Declared Bandwidth (MHz)	99% OBW (MHz)	Limit (MHz)	Result
802.11 b	2412	20	14.645	< 20	pass
	2472	20	14.645	< 20	pass
802.11 g	2412	20	16.498	< 20	pass
	2472	20	16.498	< 20	pass
802.11 n20	2412	20	17.656	< 20	pass
	2472	20	17.771	< 20	pass
802.11 n40	2422	40	36.237	< 40	pass
	2462	40	36.237	< 40	pass

Please refer to the following plots.

Ant B

2412MHz b Mode

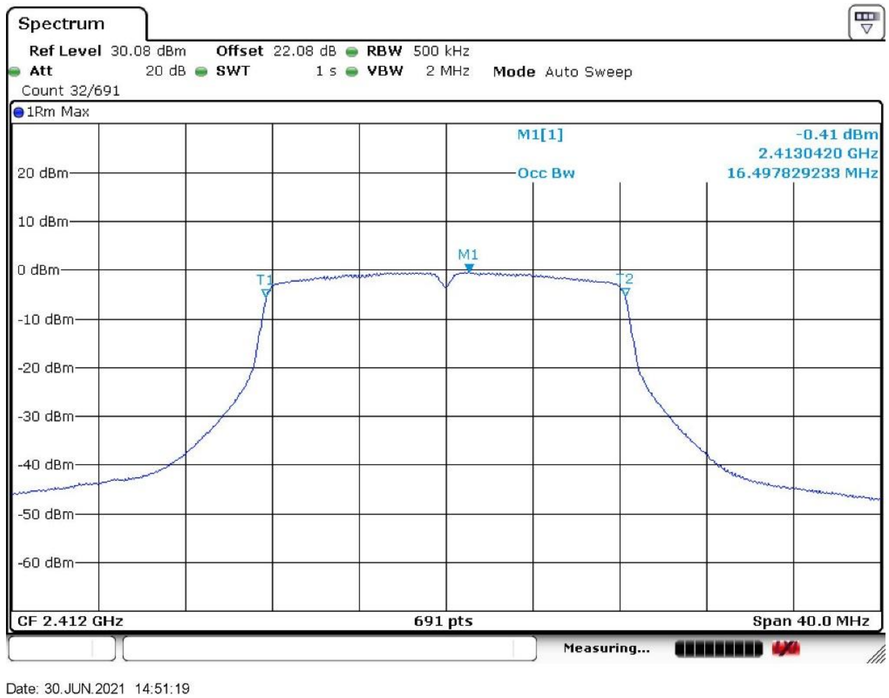


Date: 30.JUN.2021 14:54:51

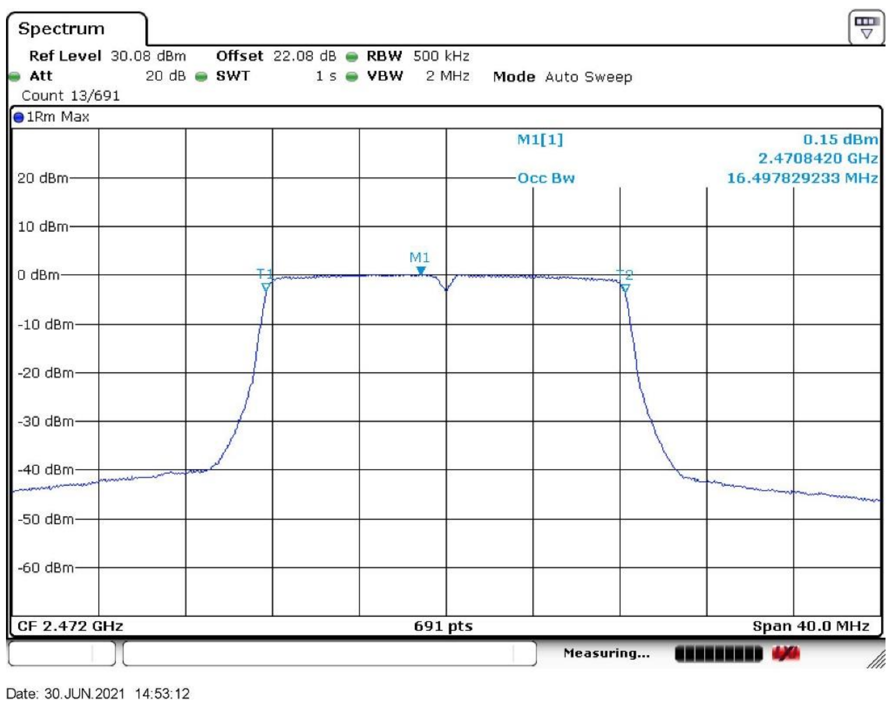
2472MHz b mode

Date: 30.JUN.2021 14:56:30

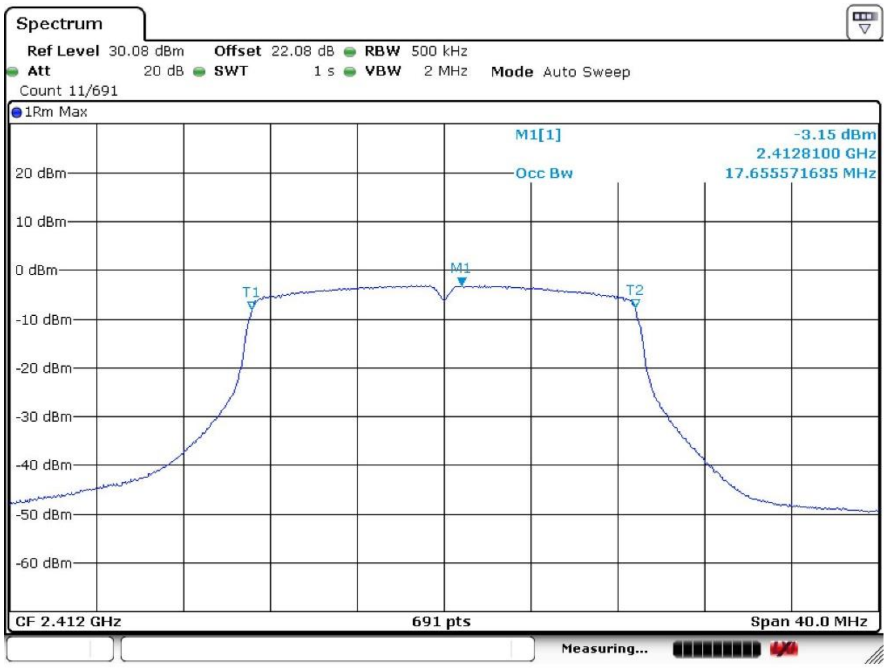
2412MHz g mode



2472MHz g mode



2412MHz n20 mode

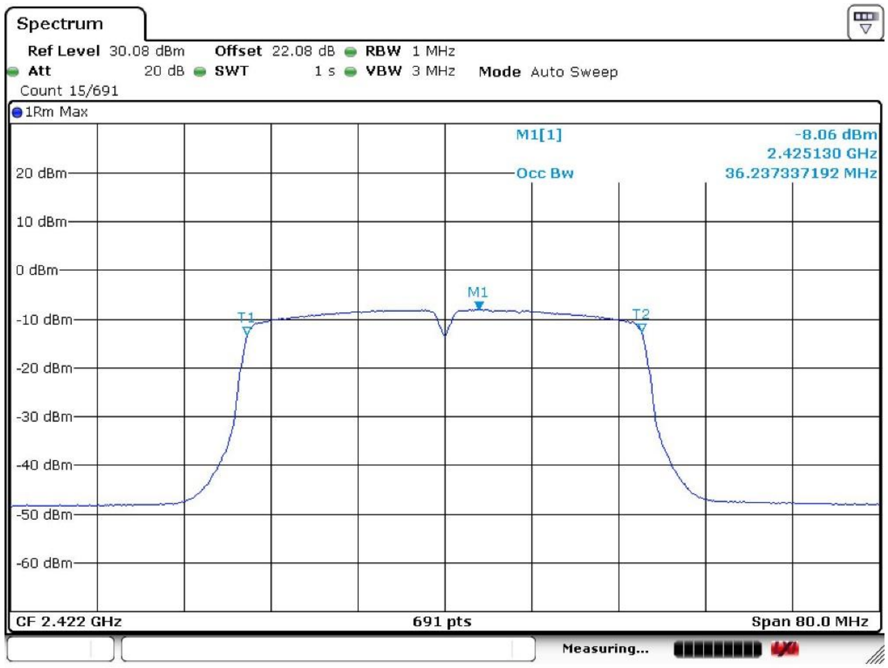


Date: 30.JUN.2021 14:58:29

2472MHz n20 mode

Date: 30.JUN.2021 15:00:21

2422MHz n40 mode



Date: 30.JUN.2021 15:04:05

2462MHz n40 mode

Date: 30.JUN.2021 15:06:36

Note: Per standard, OBW testing need only to be performed on one antenna output. Port B was selected for testing.

5 EN 300 328 Clause 4.3.2.2 – RF Output Power

5.1 Applicable Standard

For adaptive equipment using wide band modulations other than FHSS, the maximum RF output power shall be 20 dBm.

The maximum RF output power for non-adaptive equipment shall be declared by the supplier and shall not exceed 20 dBm. See clause 5.3.1 m). For non-adaptive equipment using wide band modulations other than FHSS, the maximum RF output power shall be equal to or less than the value declared by the supplier.

This limit shall apply for any combination of power level and intended antenna assembly.

5.2 Measurement Procedure

The test procedure shall be as follows:

Step 1:

- Use a fast power sensor suitable for 2.4 GHz and capable of minimum 1 MS/s.
- Use the following settings:
  - Sample speed 1 MS/s or faster.
  - The samples shall represent the RMS power of the signal.
  - Measurement duration: For non-adaptive equipment: equal to the observation period defined in clause 4.3.1.3.2 or clause 4.3.2.4.2. For adaptive equipment, the measurement duration shall be long enough to ensure a minimum number of bursts (at least 10) are captured.

NOTE 1: For adaptive equipment, to increase the measurement accuracy, a higher number of bursts may be used.

Step 2:

- For conducted measurements on devices with one transmit chain:
  - Connect the power sensor to the transmit port, sample the transmit signal and store the raw data. Use these stored samples in all following steps.
- For conducted measurements on devices with multiple transmit chains:
  - Connect one power sensor to each transmit port for a synchronous measurement on all transmit ports.
  - Trigger the power sensors so that they start sampling at the same time. Make sure the time difference between the samples of all sensors is less than 500 ns.
  - For each individual sampling point (time domain), sum the coincident power samples of all ports and store them. Use these summed samples in all following steps.

Step 3:

- Find the start and stop times of each burst in the stored measurement samples.

  The start and stop times are defined as the points where the power is at least 30 dB below the highest value of the stored samples in step 2.

NOTE 2: In case of insufficient dynamic range, the value of 30 dB may need to be reduced appropriately.

Step 4:

• Between the start and stop times of each individual burst calculate the RMS power over the burst using the formula below. Save these Pburst values, as well as the start and stop times for each burst.

$$P_{burst} = \frac{1}{k}\sum_{n=1}^{k} P_{sample}(n)$$

with 'k' being the total number of samples and 'n' the actual sample number

Step 5:

• The highest of all Pburst values (value "A" in dBm) will be used for maximum e.i.r.p. calculations.

Step 6:

• Add the (stated) antenna assembly gain "G" in dBi of the individual antenna.
• If applicable, add the additional beamforming gain "Y" in dB.

5.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
ETS- Lindgren	Power Sensor	7002-006	160097	2021-02-12	2 years
Tenney	Environmental Chamber	TUJR	2744-06	2020-06-25	14 months
-	10dB attenuator	-	-	Each time[1]	N/A

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".*

5.4 Environmental Conditions

Temperature:	23° C
Relative Humidity:	46 %
ATM Pressure:	101.1 kPa

Testing was performed by Rita Yang on 2021-07-10 at the RF site.

5.5 Test Results

Low Temperature (0 °C)

Frequency (MHz)	Conducted Output Power (dBm)		Antenna Gain (dBi)	EIRP (dBm)		Total EIRP (dBm)	EIRP Limit (dBm)
	Ant A	Ant B		Ant A	Ant B		
802.11 b mode							
2412	16.83	15.66	2.3	19.13	17.96	-	20
2437	16.68	15.3	2.3	18.98	17.6	-	20
2472	16.64	13.75	2.3	18.94	16.05	-	20
802.11 g mode							
2412	16.48	15.1	2.3	18.78	17.4	-	20
2437	16.68	15.96	2.3	18.98	18.26	-	20
2472	16.4	14.46	2.3	18.7	16.76	-	20
802.11n20 mode							
2412	11.54	10.58	5.3	16.84	15.88	19.40	20
2437	11.54	10.89	5.3	16.84	16.19	19.54	20
2472	11.89	10.1	5.3	17.19	15.4	19.40	20
802.11n40 mode							
2422	11.85	10.13	5.3	17.15	15.43	19.38	20
2437	11.9	10.58	5.3	17.2	15.88	19.60	20
2462	12.09	9.83	5.3	17.39	15.13	19.42	20

Normal Temperature (25 °C)

Frequency (MHz)	Conducted Output Power (dBm)		Antenna Gain (dBi)	EIRP (dBm)		Total EIRP (dBm)	EIRP Limit (dBm)
	Ant A	Ant B		Ant A	Ant B		
802.11 b mode							
2412	14.55	13.38	2.3	16.85	15.68	-	20
2437	14.51	13.13	2.3	16.81	15.43	-	20
2472	14.26	11.37	2.3	16.56	13.67	-	20
802.11 g mode							
2412	14.56	13.18	2.3	16.86	15.48	-	20
2437	14.4	13.68	2.3	16.7	15.98	-	20
2472	14.34	12.4	2.3	16.64	14.7	-	20
802.11n20 mode							
2412	9.5	8.54	5.3	14.8	13.84	17.36	20
2437	9.73	8.61	5.3	15.03	13.91	17.52	20
2472	9.61	7.82	5.3	14.91	13.12	17.12	20
802.11n40 mode							
2422	10.28	8.56	5.3	15.58	13.86	17.81	20
2437	10.11	8.79	5.3	15.41	14.09	17.81	20
2462	10.41	8.15	5.3	15.71	13.45	17.74	20

High Temperature (35 °C)

Frequency (MHz)	**Conducted Output Power (dBm)**		**Antenna Gain (dBi)**	**EIRP (dBm)**		**Total EIRP (dBm)**	**EIRP Limit (dBm)**
	Ant A	**Ant B**		**Ant A**	**Ant B**		
802.11 b mode							
2412	13.637	12.467	2.3	15.937	14.767	-	20
2437	13.602	12.222	2.3	15.902	14.522	-	20
2472	13.44	10.55	2.3	15.74	12.85	-	20
802.11 g mode							
2412	13.44	12.06	2.3	15.74	14.36	-	20
2437	13.37	12.65	2.3	15.67	14.95	-	20
2472	13.36	11.42	2.3	15.66	13.72	-	20
802.11n20 mode							
2412	8.33	7.37	5.3	13.63	12.67	16.19	20
2437	8.81	7.69	5.3	14.11	12.99	16.60	20
2472	8.41	6.62	5.3	13.71	11.92	15.92	20
802.11n40 mode							
2422	9.62	7.647	5.3	14.92	12.947	17.05	20
2437	9.197	7.877	5.3	14.497	13.177	16.90	20
2462	8.83	7.56	5.3	14.13	12.86	16.55	20

Note: The antenna gain provided by the customer
Note: EIRP = Conducted Power (dBm) + Antenna Gain (dBi)
Note: Total EIRP(dBm) is sum of two ports

6 EN 300 328 Clause 4.3.2.3 – Power Spectral Density

6.1 Applicable Standard

For equipment using wide band modulations other than FHSS, the maximum Power Spectral Density is limited to 10 dBm per MHz

6.2 Measurement Procedure

The transmitter shall be connected to a spectrum analyzer and the Power Spectral Density as defined in clause 4.3.2.3 shall be measured and recorded.
The test procedure shall be as follows:

Step 1:
– Connect the UUT to the spectrum analyzer and use the following settings:
- Centre Frequency: The centre frequency of the channel under test
- RBW: 1 MHz
- VBW: 3 MHz
- Frequency Span: 2 × Nominal Bandwidth (e.g. 40 MHz for a 20 MHz channel)
- Detector Mode: Peak
- Trace Mode: Max Hold

Step 2:
– When the trace is complete, find the peak value of the power envelope and record the frequency.

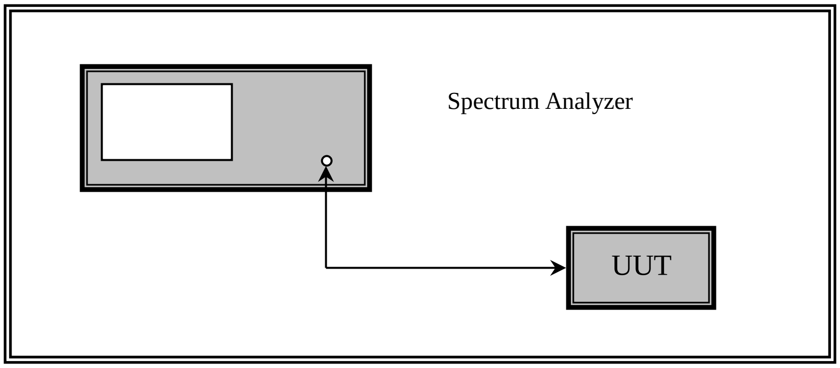
Step 3:
– Make the following changes to the settings of the spectrum analyzer:
- Centre Frequency: Equal to the frequency recorded in step 2
- Frequency Span: 3 MHz
- RBW: 1 MHz
- VBW: 3 MHz
- Sweep Time: 1 minute
- Detector Mode: RMS
- Trace Mode: Max Hold

Step 4:
– When the trace is complete, the trace shall be captured using the "Hold" or "View" option on the spectrum analyzer.
– Find the peak value of the trace and place the analyzer marker on this peak. This level is recorded as the highest mean power (power spectral density) D in a 1 MHz band.
– Alternatively, where a spectrum analyzer is equipped with a function to measure power spectral density, this function may be used to display the power spectral density D in dBm / MHz
– In case of conducted measurements on smart antenna systems operating in a mode with multiple transmit chains active simultaneously, the power spectral density of each transmit chain shall be measured separately to calculate the total power spectral density (value D in dBm / MHz) for the UUT.

Step 5:
- The maximum Power Spectral Density (PSD) e.i.r.p. is calculated from the above measured power spectral density D, the observed Duty Cycle (DC) (see clause 5.4.2.2.1.3, step 4), the applicable antenna assembly gain G in dBi and if applicable the beamforming gain Y in dB, according to the formula below. This value shall be recorded in the test report. If more than one antenna assembly is intended for this power setting, the gain of the antenna assembly with the highest gain shall be used.

$$PSD = D + G + Y + 10 \times \log (1 / DC) \text{ (dBm / MHz)}$$

6.3 Test Setup Block Diagram



6.4 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Signal Analyzer	E4446A	MY48250238	2021-02-12	12 months
-	RF cable	-	-	Each time[1]	N/A
-	10 dB attenuator	-	-	Each time[1]	N/A

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".*

6.5 Environmental Conditions

Temperature:	23° C
Relative Humidity:	46 %
ATM Pressure:	101.1 kPa

Testing was performed by Rita Yang from 2021-07-19 to 2021-07-28 at the RF site.

6.6 Test Results

Frequency (MHz)	Measured PSD (dBm/MHz)		Duty Cycle (%)	Corrected PSD (dBm/MHz)		Antenna Gain (dBi)	EIRP PSD (dBm/MHz)		Limit (dBm/MHz)
	ANT A	ANT B		ANT A	ANT B		ANT A	ANT B	
802.11b mode									
2412	6.07	6.54	96.58	6.22	6.69	2.3	8.52	8.99	10
2437	7.43	6.1	96.58	7.58	6.25	2.3	9.88	8.55	10
2472	7.45	4.56	96.58	7.60	4.7	2.3	9.90	7.00	10
802.11g mode									
2412	5.26	3.88	92.50	5.60	4.22	2.3	7.90	6.52	10
2437	5.33	4.71	92.50	5.67	5.05	2.3	7.97	7.35	10
2472	4.75	2.81	92.50	5.09	3.15	2.3	7.39	5.45	10

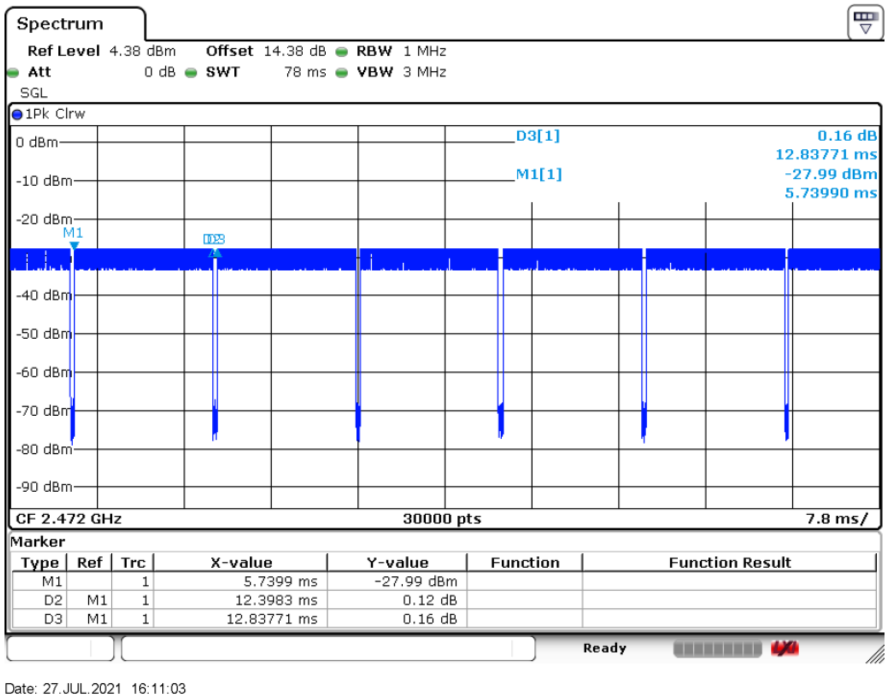
Note: Corrected PSD (dBm/MHz) = Measured PSD (dBm/MHz) + 10*log(1/x), where x is duty cycle.
Note: EIRP PSD = Corrected PSD (dBm/MHz) + antenna gain (dBi)
Note: 2.3 dBi is the individual antenna gain, which was provided by customer

Frequency (MHz)	Measured PSD (dBm/MHz)		Duty Cycle (%)	Corrected PSD (dBm/MHz)		Combined PSD (dBm/MHz)	Combined Antenna Gain(dBi)	Combined EIRP PSD (dBm/MHz)	Limit (dBm/MHz)
	ANT A	ANT B		ANT A	ANT B				
802.11n20 mode									
2412	0.31	-0.65	92.34	0.66	-0.30	3.22	5.3	8.52	10
2437	0.28	-0.35	92.34	0.63	0.005	3.34	5.3	8.64	10
2472	1.22	-0.50	92.34	1.57	-0.149	3.81	5.3	9.11	10
802.11n40 mode									
2422	-2.276	-3.9	80.73	1.69	-0.029	0.89	5.3	6.22	10
2437	-1.362	-2.652	80.73	-1.386	-3.01	1.95	5.3	7.28	10
2462	-1.708	-3.878	80.73	-0.472	-1.762	1.24	5.3	6.58	10

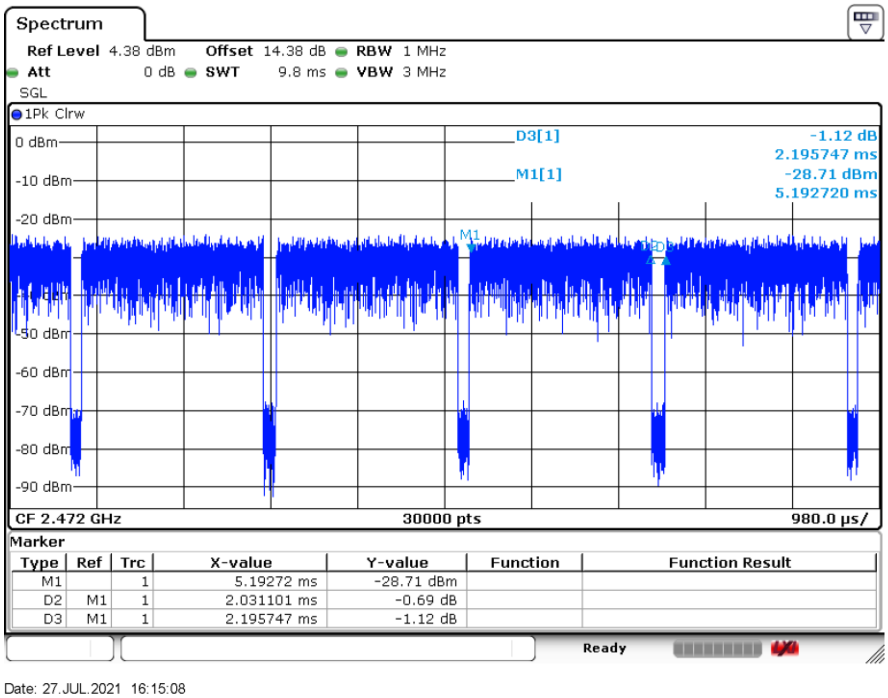
Note: Corrected PSD (dBm/MHz) = Measured PSD (dBm/MHz) + 10*log(1/x), where x is duty cycle.
Note: Combined PSD is sum of both ports
Note: Combined EIRP PSD = Combined PSD(dBm/MHz) + Beamforming Gain (dBi)
Note: 5.3 dBi is the MIMO antenna gain calculated using the following equation: Combined antenna gain = individual antenna gain (dBi) + 10*log(number of antenna) = 2.3 dBi + 10*log(2) = 5.3 dBi.

Duty Cycle:

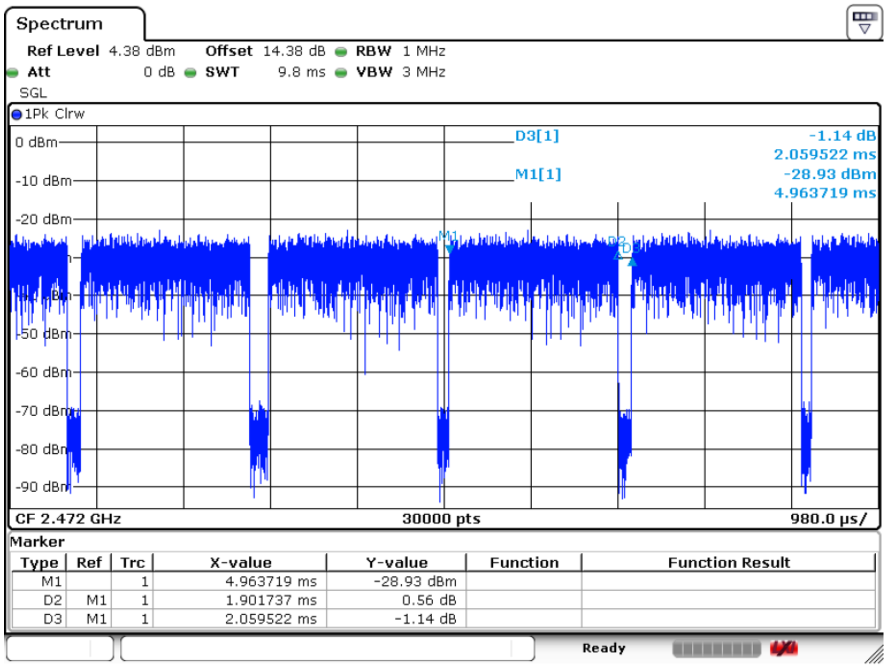
802.11b mode



802.11g mode

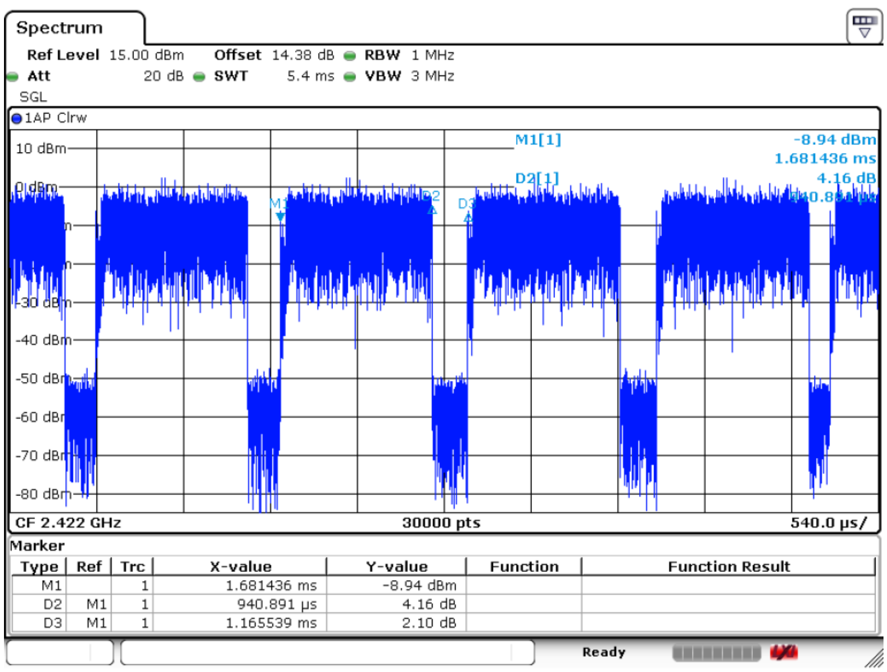


802.11n20 mode



Date: 27.JUL.2021 16:18:41

802.11n40 mode



Date: 28.JUL.2021 09:50:27

7 EN 300 328 Clause 4.3.2.8 – TX Unwanted Emissions in the out of Band Domain

7.1 Applicable Standard

The transmitter unwanted emissions in the out-of-band domain but outside the allocated band, shall not exceed the values provided by the mask in figure 1.

NOTE:
Within the 2 400 MHz to 2 483.5 MHz band, the Out-of-band emissions are fulfilled by compliance with the Occupied Channel Bandwidth requirement in clause 4.3.1.8.

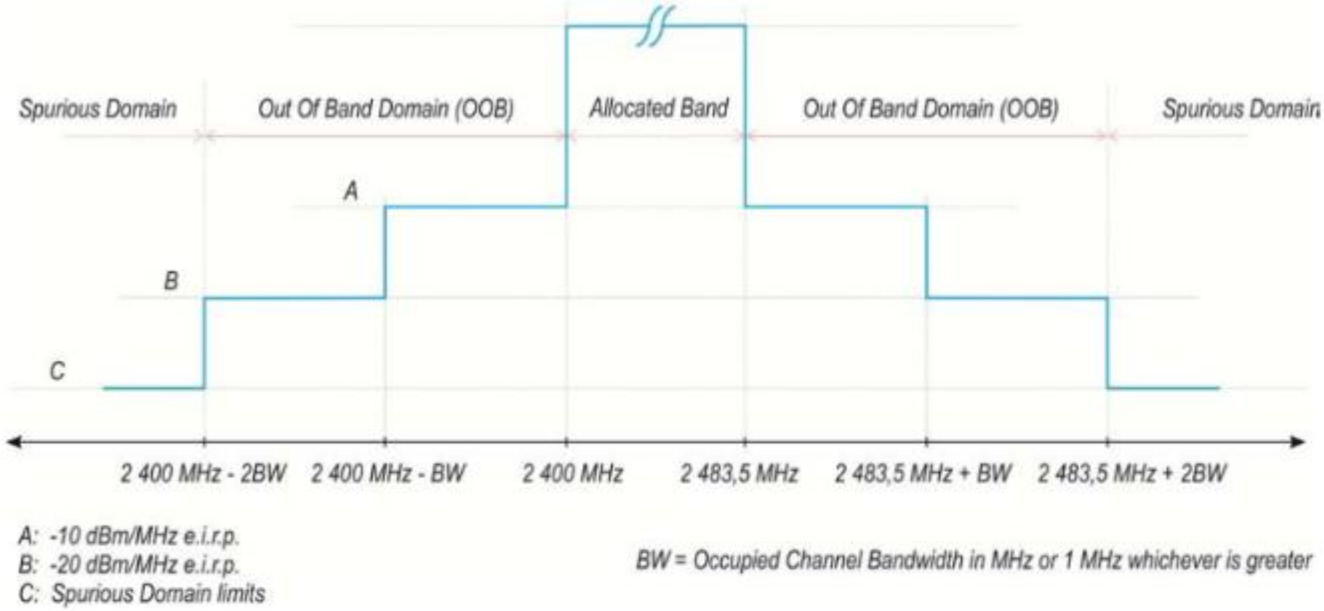


Figure 1: Transmit mask

7.2 Measurement Procedure

The applicable mask is defined by the measurement results from the tests performed under clause 5.3.8 (Occupied Channel Bandwidth).
The Out-of-band emissions within the different horizontal segments of the mask provided in figures 1 and 3 shall be measured using the steps below. This method assumes the spectrum analyzer is equipped with the Time Domain Power option.

Step 1:
- Connect the UUT to the spectrum analyzer and use the following settings:
  - Centre Frequency: 2 484 MHz
  - Span: 0 Hz
  - Resolution BW: 1 MHz
  - Filter mode: Channel filter
  - Video BW: 3 MHz
  - Detector Mode: RMS
  - Trace Mode: Max Hold
  - Sweep Mode: Continuous
  - Sweep Points: Sweep Time [s] / (1 μs) or 5 000 whichever is greater
  - Trigger Mode: Video trigger

NOTE 1: In case video triggering is not possible, an external trigger source may be used.

- Sweep Time: > 120 % of the duration of the longest burst detected during the measurement of the RF Output Power

Step 2 (segment 2 483.5 MHz to 2 483.5 MHz + BW):

• Adjust the trigger level to select the transmissions with the highest power level.

• For frequency hopping equipment operating in a normal hopping mode, the different hops will result in signal bursts with different power levels. In this case the burst with the highest power level shall be selected.

• Set a window (start and stop lines) to match with the start and end of the burst and in which the RMS power shall be measured using the Time Domain Power function.

• Select RMS power to be measured within the selected window and note the result which is the RMS power within this 1 MHz segment (2 483,5 MHz to 2 484,5 MHz). Compare this value with the applicable limit provided by the mask.

• Increase the centre frequency in steps of 1 MHz and repeat this measurement for every 1 MHz segment within the range 2 483,5 MHz to 2 483,5 MHz + BW. The centre frequency of the last 1 MHz segment shall be set to 2 483,5 MHz + BW - 0,5 MHz (which means this may partly overlap with the previous 1 MHz segment).

Step 3 (segment 2 483,5 MHz + BW to 2 483,5 MHz + 2BW):

• Change the centre frequency of the analyser to 2 484 MHz + BW and perform the measurement for the first 1 MHz segment within range 2 483,5 MHz + BW to 2 483,5 MHz + 2BW. Increase the centre frequency in 1 MHz steps and repeat the measurements to cover this whole range. The centre frequency of the last 1 MHz segment shall be set to 2 483,5 MHz + 2 BW - 0,5 MHz (which means this may partly overlap with the previous 1 MHz segment).

Step 4 (segment 2 400 MHz - BW to 2 400 MHz):

• Change the centre frequency of the analyser to 2 399,5 MHz and perform the measurement for the first 1 MHz segment within range 2 400 MHz - BW to 2 400 MHz Reduce the centre frequency in 1 MHz steps and repeat the measurements to cover this whole range. The centre frequency of the last 1MHz segment shall be set to 2 400 MHz - BW + 0,5 MHz (which means this may partly overlap with the previous 1 MHz segment).

Step 5 (segment 2 400 MHz - 2BW to 2 400 MHz - BW):

• Change the centre frequency of the analyser to 2 399,5 MHz - BW and perform the measurement for the first 1 MHz segment within range 2 400 MHz - 2BW to 2 400 MHz - BW. Reduce the centre frequency in 1 MHz steps and repeat the measurements to cover this whole range. The centre frequency of the last 1 MHz segment shall be set to 2 400 MHz - 2BW + 0,5 MHz (which means this may partly overlap with the previous 1 MHz segment).

Step 6:

• In case of conducted measurements on equipment with a single transmit chain, the declared antenna assembly gain "G" in dBi shall be added to the results for each of the 1 MHz segments and compared with the limits provided by the mask given in figure 1 or figure 3. If more than one antenna assembly is intended for this power setting, the antenna with the highest gain shall be considered.

• In case of conducted measurements on smart antenna systems (equipment with multiple transmit chains), the measurements need to be repeated for each of the active transmit chains. The declared antenna assembly gain "G" in dBi for a single antenna shall be added to these results. If more than one antenna assembly is intended for this power setting, the antenna with the highest gain shall be considered. Comparison with the applicable limits shall be done using any of the options given below:

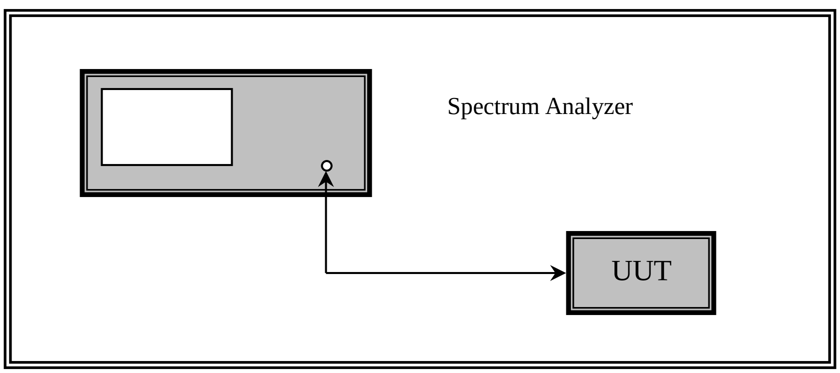
- Option 1: the results for each of the transmit chains for the corresponding 1 MHz segments shall be added. The additional beamforming gain "Y" in dB shall be added as well and the resulting values compared with the limits provided by the mask given in figure 1 or figure 3.

- Option 2: the limits provided by the mask given in figure 1 or figure 3 shall be reduced by 10 × log10(Ach) and the additional beamforming gain "Y" in dB. The results for each of the transmit chains shall be individually compared with these reduced limits.

NOTE 2: Ach refers to the number of active transmit chains.

It shall be recorded whether the equipment complies with the mask provided in figure 1 or figure 3.

7.3 Test Setup Block Diagram



7.4 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Rhode&Schwarz	Signal Analyzer	FSV40	101203	2021-04-26	12 Months
-	RF cable	-	-	Each time[1]	N/A
-	10 dB attenuator	-	-	Each time[1]	N/A

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".*

7.5 Environmental Conditions

Temperature:	23 °C
Relative Humidity:	46 %
ATM Pressure:	101.1 kPa

Testing was performed by Rita Yang from 2021-07-07 to 2021-07-28 at RF site.

7.6 Test Results

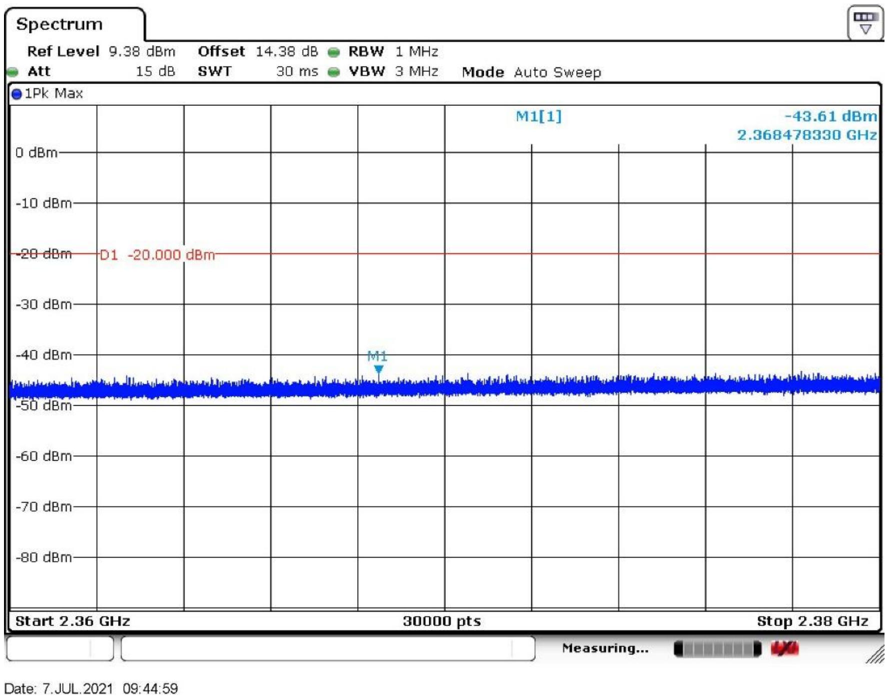
The following table represents the highest emissions in the out-of-band domain for Wi-Fi.
(Worse case of 802.11b, g, n20 and n40: L/H Channels)

Modulation	Channel	Frequency Range (MHz)	Maximum EIRP Emissions (dBm/MHz)		Limit (dBm/MHz)
			Ant A	Ant B	
802.11b mode	Low	2360 - 2380	-43.61	-43.03	-20
		2380 - 2400	-20.56	-23.43	-10
	High	2483.5-2503.5	-18.23	-24.41	-10
		2503.5-2523.5	-42.12	-44.05	-20
802.11n40 mode	Low	2320-2360	-35.95	-37.02	-20
		2360-2400	-14.04	-17.05	-10
	High	2483.5 - 2523.5	-14.65	-18.28	-10
		2523.5 - 2563.5	-36.68	-39.47	-20

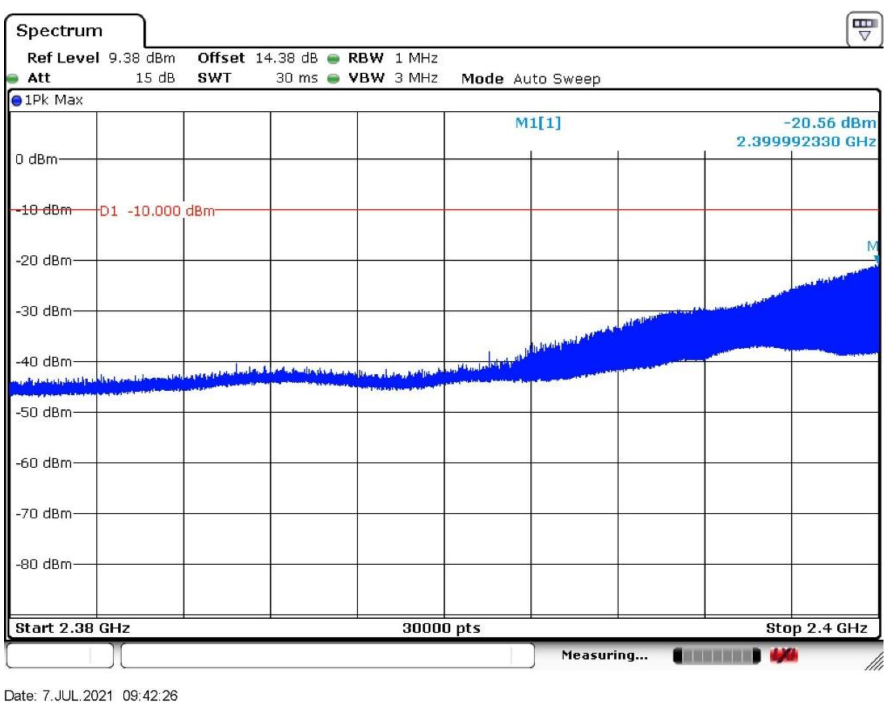
Tx Unwanted Emissions in the out of band domain
802.11b mode

Note: measurement offset 14.38 dB = cable loss + attenuation + individual antenna gain (2.3 dBi)

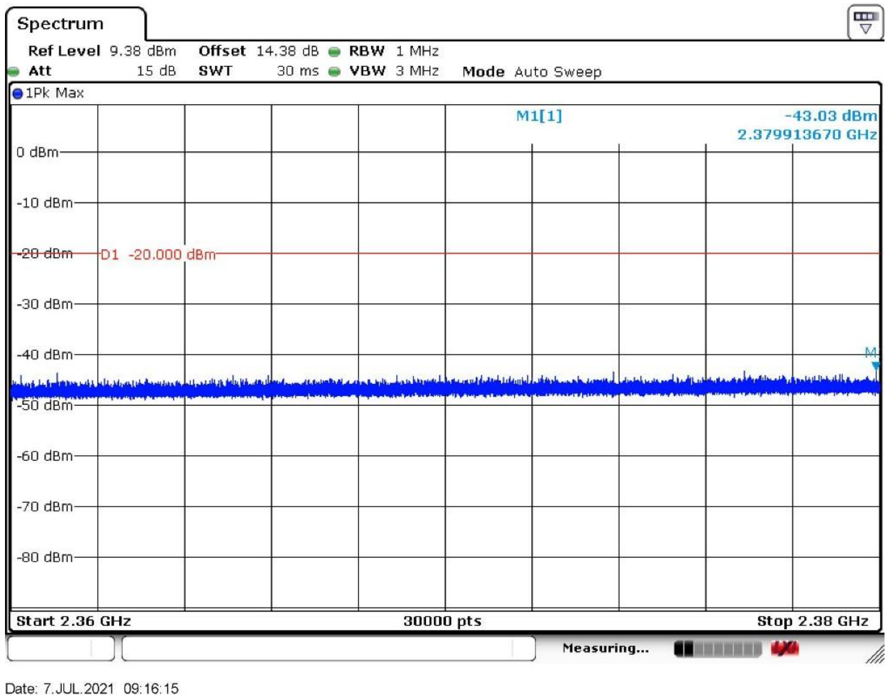
Low Channel Ant A 2360MHz-2380MHz



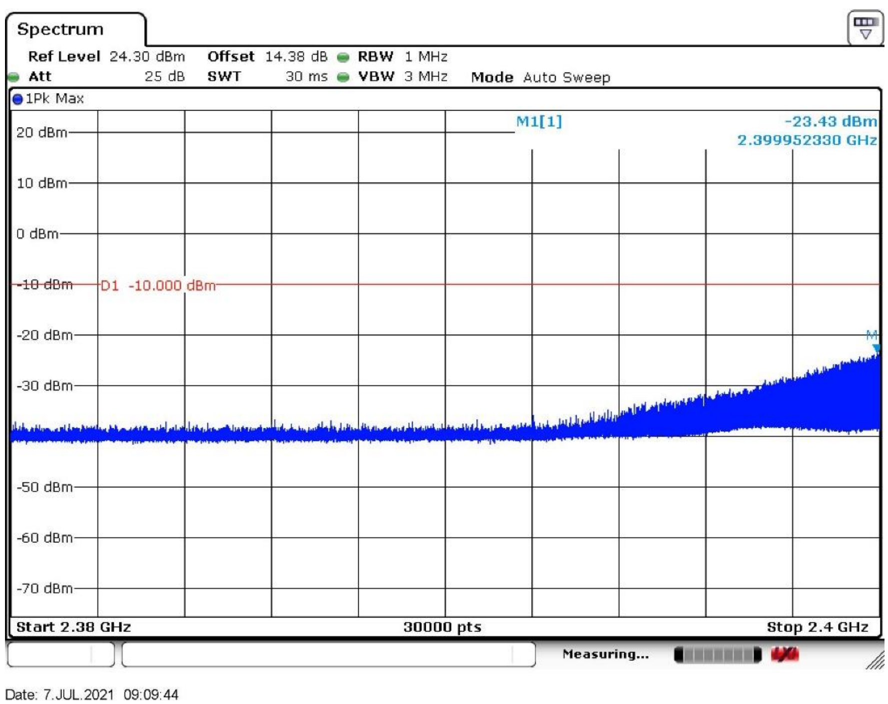
Low Channel Ant A 2380MHz-2400MHz



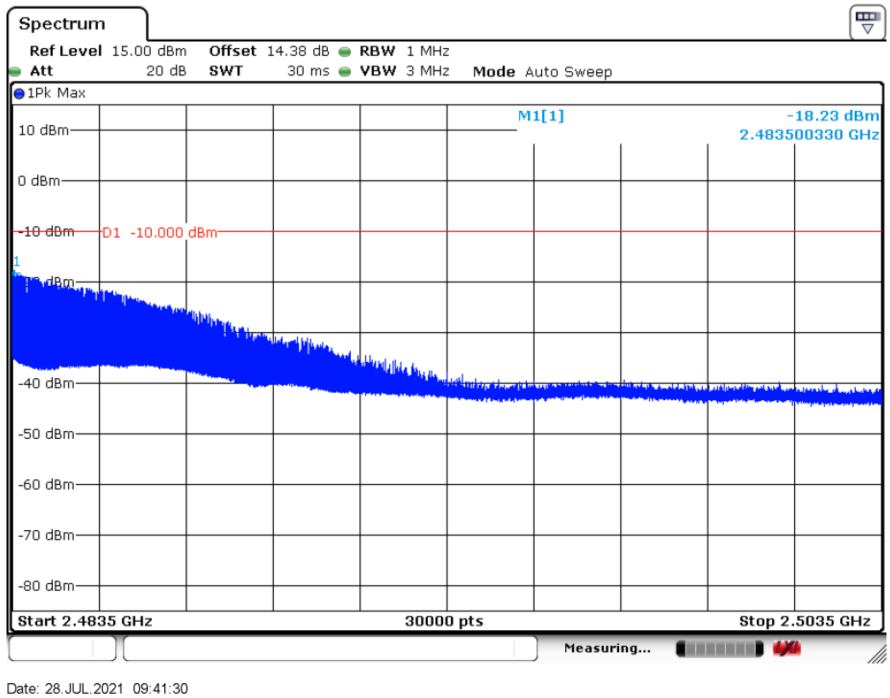
Low Channel Ant B 2360MHz-2380MHz



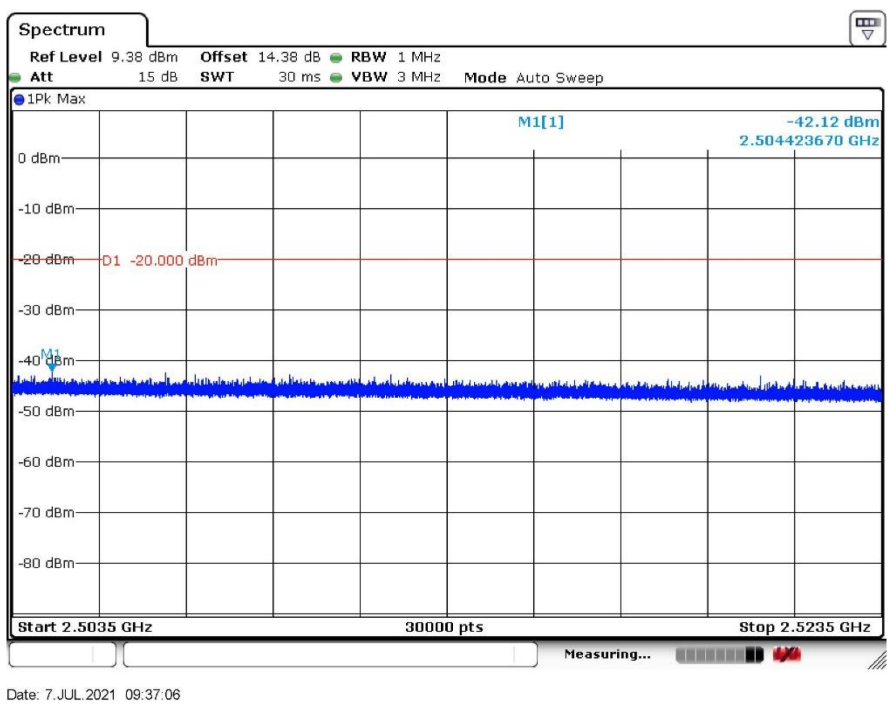
Low Channel Ant B 2380MHz-2400MHz



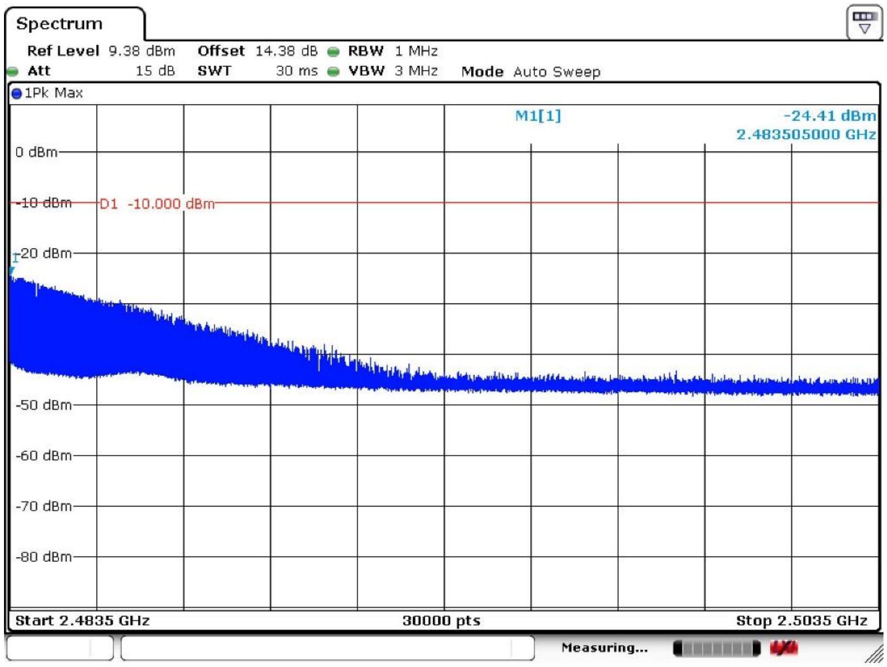
High Channel Ant A 2483.5MHz-2503.5MHz



High Channel Ant A 2503.5MHz-2523.5MHz

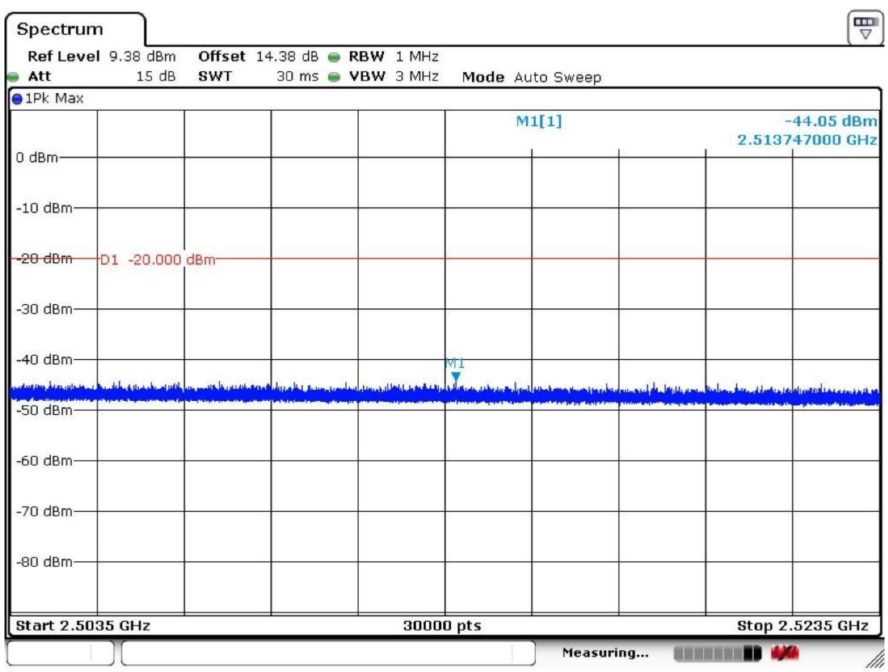


High Channel Ant B 2483.5MHz-2503.5MHz



Date: 7.JUL.2021 09:28:29

High Channel Ant B 2503.5MHz-2523.5MHz



Date: 7.JUL.2021 09:30:55

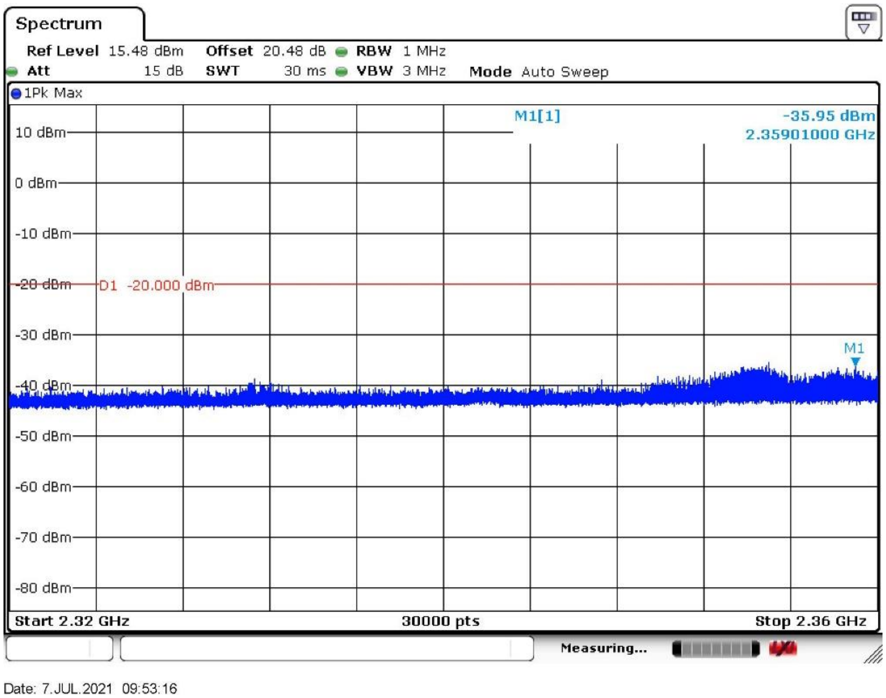
802.11n40 mode

Note: measurement offset 20.48 dB = cable loss + attenuation + individual antenna gain (2.3 dBi) + multi-chain factor + beamforming gain

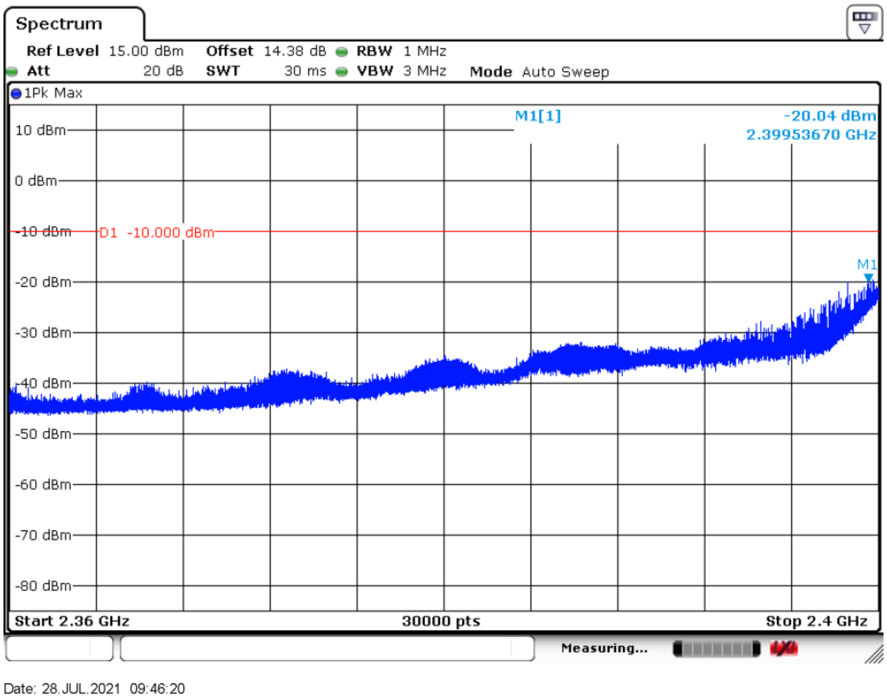
Multi-chain factor = 10*log(A_{ch}), where A_{ch} is number of transmit chains.

Beamforming gain = 10*log(number of antenna)

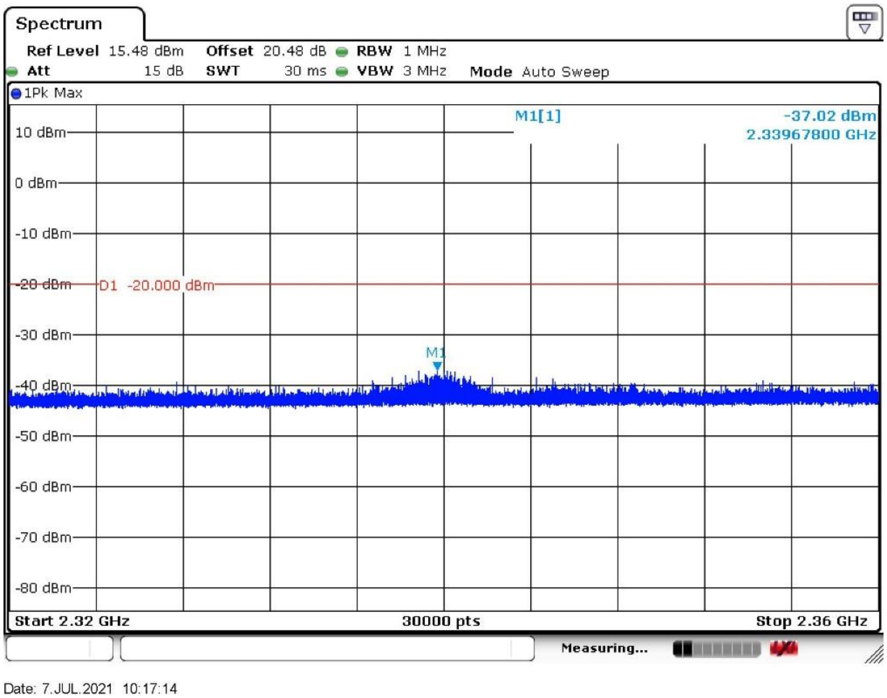
Low Channel Ant A 2320MHz-2360MHz



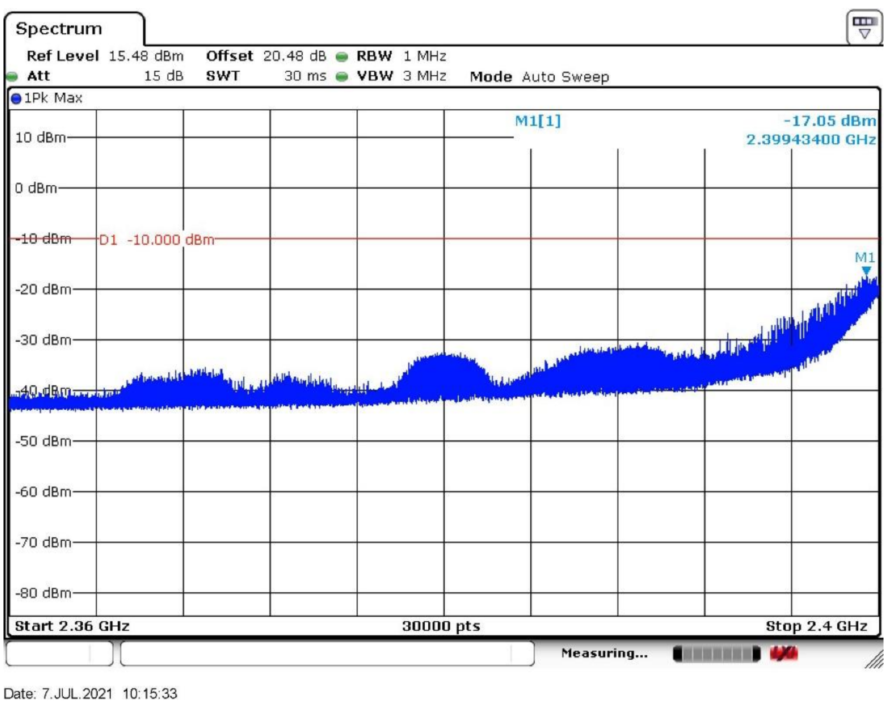
Low Channel Ant A 2360MHz-2400MHz



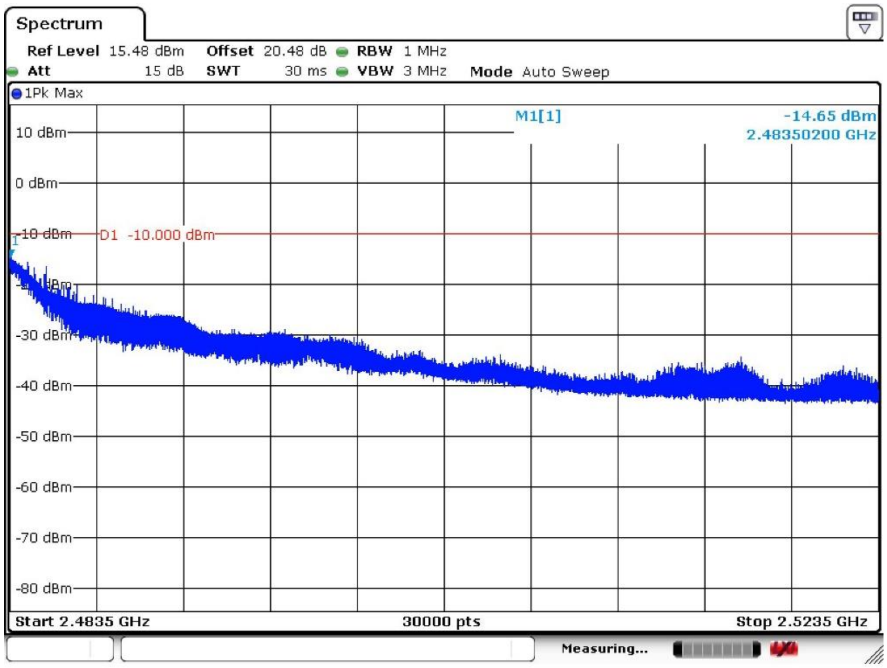
Low Channel Ant B 2320MHz-2360MHz



Low Channel Ant B 2360MHz-2400MHz

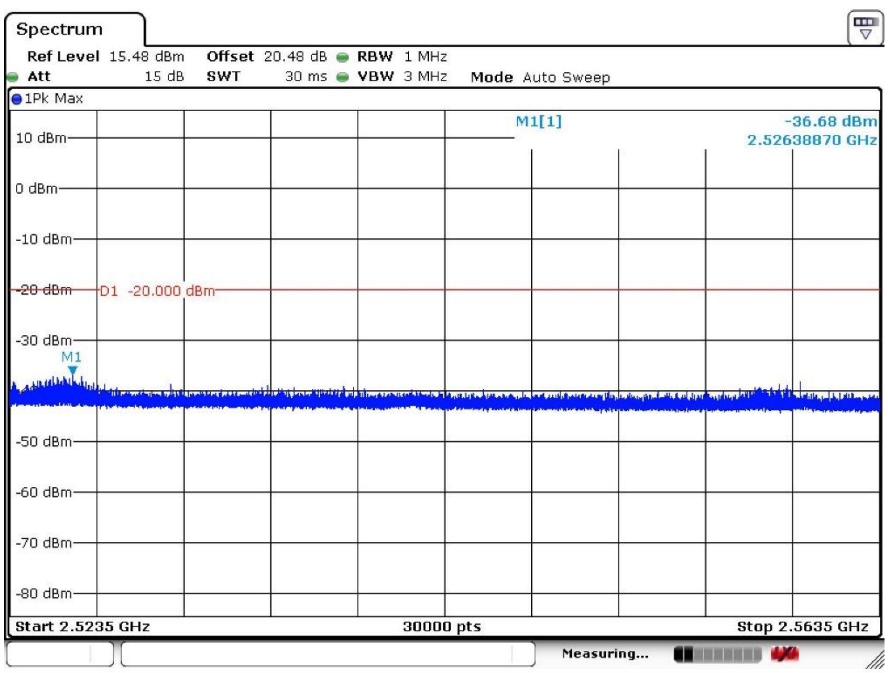


High Channel Ant A 2483.5MHz-2523.5MHz



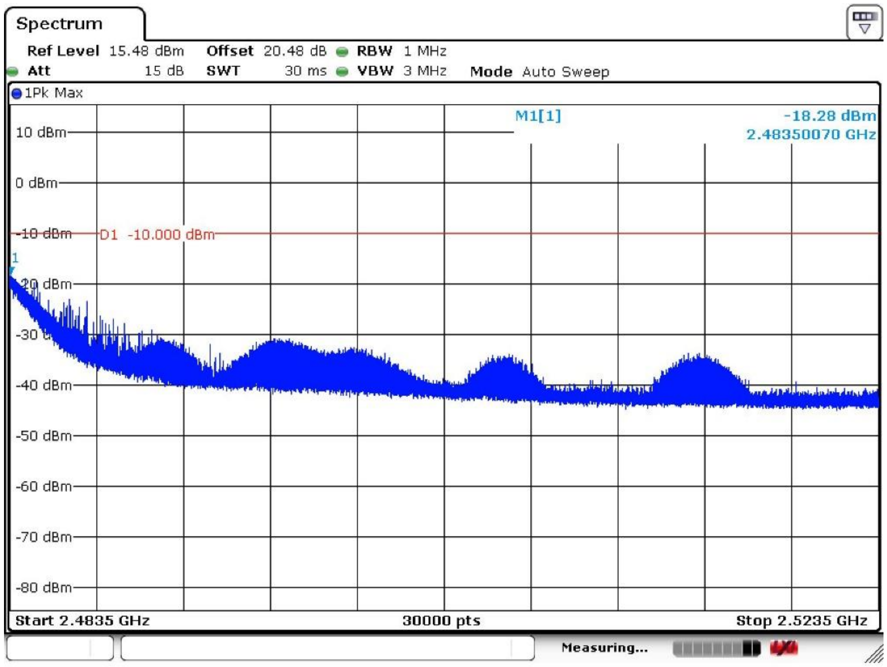
Date: 7.JUL.2021 09:56:47

High Channel Ant A 2523.5MHz-2563.5MHz



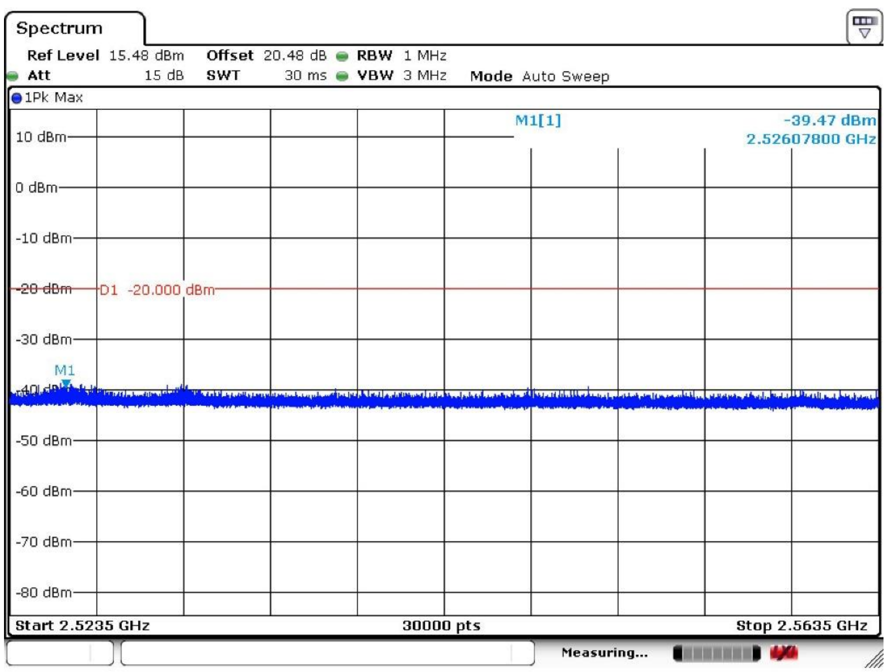
Date: 7.JUL.2021 09:59:42

High Channel Ant B 2483.5MHz-2523.5MHz



Date: 7.JUL.2021 10:06:27

High Channel Ant B 2523.5MHz-2563.5MHz



Date: 7.JUL.2021 10:12:12

8 EN 300 328 Clause 4.3.2.9 – TX Unwanted emissions in the Spurious Domain

8.1 Applicable Standard

According to Clause 4.3.2.9.3, the transmitter unwanted emissions in the spurious domain shall not exceed the values given in the table below,

In case of equipment with antenna connectors, these limits apply to emissions at the antenna port (conducted). For emissions radiated by the cabinet or emissions radiated by integral antenna equipment (without antenna connectors), these limits are e.r.p. for emissions up to 1 GHz and as e.i.r.p. for emissions above 1 GHz.

Transmitter limits for spurious emissions

Frequency Range	Maximum Power	Bandwidth
30 MHz to 47 MHz	-36 dBm	100 kHz
47 MHz to 74 MHz	-54 dBm	100 kHz
74 MHz to 87.5 MHz	-36 dBm	100 kHz
87.5 MHz to 118 MHz	-54 dBm	100 kHz
118 MHz to 174 MHz	-36 dBm	100 kHz
174 MHz to 230 MHz	-54 dBm	100 kHz
230 MHz to 470 MHz	-36 dBm	100 kHz
470 MHz to 694 MHz	-54 dBm	100 kHz
694 MHz to 1 GHz	-36 dBm	100 kHz
1 GHz to 12.75 GHz	-30 dBm	1 MHz

8.2 UUT Setup

The radiated emissions tests were performed in a shield room, using the setup accordance with the EN 300 328 V2.2.2(2019-07), the specification used was the EN 300 328 V2.2.2 limits.

External I/O cables were draped along the edge of the test table and bundle when necessary.

8.3 Measurement Procedure

Any emissions that exceed the limit or come within 6 dB below the limits were evaluated. All of the emissions were evaluated using an average detector.

8.4 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Rhode & Schwarz	Signal Analyzer	FSV40	101203	2021-04-26	12 months
Agilent	Spectrum Analyzer	E4446A	MY48250238	2021-02-12	12 months
Rhode & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100044	2021-05-14	2 years
Sunol Science Corp	System Controller	SC99V	011003-1	N/R	N/A
Sunol Science	Biconilog Antenna	JB3	A020106-2	2019-11-20	2 years
ETS Lindgren	Horn Antenna	3117	00218973	2019-02-13	2.5 years
A.R.A.	Antenna, Horn	DRG-118/A	1132	2020-02-25	2 years
COM-POWER	Antenna, Dipole	AD-100 DB-4	721033DB1,721033DB2,721033DB3,521921	2021-04-30	2 years
Agilent	Signal Generator	8648C	3426A00417	2020-03-24	18 months
Agilent	Preamplifier	8449B	3147A00400	2021-03-02	1 year
HP	Pre Amplifier	8447D	2443A04374	2020-08-17	1 year
Fairview Microwave	Times Microwave LMR 400 UltraFex Coaxial Cable 35'	FMC0101405-420	BACL1904161	2021-06-18	1 year
Insulated Wire Corp.	157 Series 2.92 SM (x2) Armored 33 ft. Cable	KPS-1571AN-3960-KPS	DC 1917	2021-03-03	1 year
-	SMA cable	-	-	Each time[1]	N/A

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".*

8.5 Environmental Conditions

Temperature:	23° C
Relative Humidity:	46 %
ATM Pressure:	101.1 kPa

Testing was performed by Rita Yang from 2021-07-07 to 2021-07-22 in 5 meter chamber 3.

8.6 Summary of Test Results

According to the data in following tables, the UUT complied with the EN 300 328 V2.2.2 standards and had the worst margin of:

-6.63dB at **720.12 MHz** in the Horizontal polarization, 802.11 b mode, high channel

8.7 Test Results

Radiated Spurious Emission (30 MHz – 12.75 GHz) and second harmonics for Worst Case:

802.11 b mode Low Channel 2412MHz

Freq. (MHz)	S.A. Amp. (dBµV)	Table Azimuth (Degrees)	Test Antenna		Substitution				Absolute Level (dBm)	EN 300 328	
			Height (cm)	Polar (H/V)	Freq. (MHz)	S.G. Level (dBm)	Antenna Gain (dBi/dBd)	Cable Loss (dB)		Limit (dBm)	Margin (dB)
720.12	33.56	280	220	H	720.12	-61.25	1	0.63	-60.88	-54	-6.88
720.12	27.9	200	170	V	720.12	-63.97	1	0.63	-63.6	-54	-9.6
959.77	46.15	280	220	H	959.77	-44.27	1	0.85	-44.12	-36	-8.12
959.77	42.52	200	170	V	959.77	-45.64	1	0.85	-45.49	-36	-9.49
4824	47.16	0	100	H	4844	-49.6	10.699	1.21	-40.111	-30	-10.111
4824	47.25	0	100	V	4844	-49.97	10.699	1.21	-40.481	-30	-10.481

802.11 b mode High Channel 2472MHz

Freq. (MHz)	S.A. Amp. (dBµV)	Table Azimuth (Degrees)	Test Antenna		Substitution				Absolute Level (dBm)	EN 300 328	
			Height (cm)	Polar (H/V)	Freq. (MHz)	S.G. Level (dBm)	Antenna Gain (dBi/dBd)	Cable Loss (dB)		Limit (dBm)	Margin (dB)
720.12	33.81	320	160	H	720.12	-61	1	0.63	-60.63	-54	-6.63
720.12	28.44	210	130	V	720.12	-63.43	1	0.63	-63.06	-54	-9.06
959.77	45.14	320	160	H	959.77	-45.28	1	0.85	-45.13	-36	-9.13
959.77	40.73	210	130	V	959.77	-47.43	1	0.85	-47.28	-36	-11.28
4944	46.11	0	100	H	4924	-50.82	10.719	1.07	-41.171	-30	-11.171
4944	45.99	0	100	V	4924	-51.58	10.719	1.07	-41.931	-30	-11.931

Note: b mode was determined to be the worst case situation with respect to spurious emissions.

9 EN 300 328 Clause 4.3.2.10 Receiver spurious emissions

9.1 Applicable Standard

According to EN 300 328 V2.2.2(2019-07) Clause 4.3.2.10.3, the spurious emissions of the receiver shall not exceed the values in following table.

In case of non-FHSS equipment with antenna connectors, these limits apply to emission sat the antenna port (conducted). For emissions radiated by the cabinet or for emissions radiated by integral antenna equipment (without antenna connectors), these limits are e.r.p. for emissions up to 1 GHz and e.i.r.p. for emissions above 1 GHz.

Frequency Range	Maximum Power	Bandwidth
30 MHz to 1 GHz	-57 dBm	100 kHz
1 GHz to 12.75 GHz	-47 dBm	1 MHz

9.2 UUT Setup

The radiated emissions tests were performed in a shield room, using the setup accordance with the EN 300 328 V2.2.2(2019-07), the specification used was the EN 300 328 V2.2.2 limits.

External I/O cables were draped along the edge of the test table and bundle when necessary.

9.3 Measurement Procedure

Any emissions that exceed the limit or come within 6 dB below the limits were evaluated. All of the emissions were evaluated using an average detector.

9.4 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Rhode & Schwarz	Signal Analyzer	FSV40	101203	2021-04-26	12 months
Agilent	Spectrum Analyzer	E4446A	MY48250238	2021-02-12	12 months
Rhode & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100044	2021-05-14	2 years
Sunol Science Corp	System Controller	SC99V	011003-1	N/R	N/A
Sunol Science	Biconilog Antenna	JB3	A020106-2	2019-11-20	2 years
ETS Lindgren	Horn Antenna	3117	00218973	2019-02-13	2.5 years
A.R.A.	Antenna, Horn	DRG-118/A	1132	2020-02-25	2 years
COM-POWER	Antenna, Dipole	AD-100 DB-4	721033DB1,721033DB2,721033DB3,521921	2021-04-30	2 years
Agilent	Signal Generator	8648C	3426A00417	2020-03-24	18 months
Agilent	Preamplifier	8449B	3147A00400	2021-03-02	1 year
HP	Pre Amplifier	8447D	2443A04374	2020-08-17	1 year
Fairview Microwave	Times Microwave LMR 400 UltraFex Coaxial Cable 35'	FMC0101405-420	BACL1904161	2021-06-18	1 year
Insulated Wire Corp.	157 Series 2.92 SM (x2) Armored 33 ft. Cable	KPS-1571AN-3960-KPS	DC 1917	2021-03-03	1 year
-	SMA cable	-	-	Each time[1]	N/A

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".*

9.5 Environmental Conditions

Temperature:	23 °C
Relative Humidity:	46 %
ATM Pressure:	101.1 kPa

Testing was performed by Rita Yang from 2021-07-07 to 2021-07-22 in 5 meter chamber 3.

9.6 Summary of Test Results

According to the recorded data, the UUT complied with the EN 300 328 V2.2.2 standards' limits and had the worst margin of:

-4.19 dB at 720 MHz in the Horizontal polarization

Please refer to the following table and plots for detailed test results

9.7 Test Results

Rx radiated spurious emission:

Freq. (MHz)	S.A. Amp. (dBμV)	Table Azimuth (Degrees)	Test Antenna		Substitution				Absolute Level (dBm)	EN 300 328	
			Height (cm)	Polar (H/V)	Freq. (MHz)	S.G. Level (dBm)	Antenna Gain (dBi/dBd)	Cable Loss (dB)		Limit (dBm)	Margin (dB)
720	33.25	280	220	H	720.12	-61.56	1	0.63	-61.19	-57	-4.19
720	29.67	200	170	V	720.12	-62.2	1	0.63	-61.83	-57	-4.83
1087	50.02	0	100	H	1087	-60.19	3.3	0.24	-57.13	-47	-10.13
1087	48.93	0	100	V	1087	-61.33	3.3	0.24	-58.27	-47	-11.27

10 EN 300 328 Clause 4.3.2.11 – Receiver Blocking

10.1 Applicable Standard

ETSI EN 300 328 v2.2.2 Clause 4.3.2.11

Receiver blocking is a measure of the ability of the equipment to receive a wanted signal on its operating channel without exceeding a given degradation due to the presence of an unwanted input signal (blocking signal) at frequencies other than those of the operating band and spurious responses.

According to 4.3.2.11.3 and 4.3.2.11.4: For equipment that supports a PER or FER test to be performed, the minimum performance criterion shall be a PER or FER less than or equal to 10 %. For equipment that does not support a PER or a FER test to be performed, the minimum performance criterion shall be no loss of the wireless transmission function needed for the intended use of the equipment.

While maintaining the minimum performance criteria as defined in clause 4.3.2.11.3, the blocking levels at specified frequency offsets shall be equal to or greater than the limits defined for the applicable receiver category provided in table 14, table 15 or table 16.

Table 14: Receiver Blocking parameters for Receiver Category 1 equipment

Wanted signal mean power from companion device (dBm) (see notes 1 and 4)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 4)	Type of blocking signal
(-133 dBm + 10 × $\log_{10}$(OCBW)) or -68 dBm whichever is less (see note 2)	2 380 2 504	-34	CW
(-139 dBm + 10 × $\log_{10}$(OCBW)) or -74 dBm whichever is less (see note 3)	2 300 2 330 2 360 2 524 2 584 2 674		

NOTE 1: OCBW is in Hz.
NOTE 2: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to P_{min} + 26 dB where P_{min} is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal.
NOTE 3: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to P_{min} + 20 dB where P_{min} is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal.
NOTE 4: The level specified is the level at the UUT receiver input assuming a 0 dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2.

Table 15: Receiver Blocking parameters receiver Category 2 equipment

Wanted signal mean power from companion device (dBm) (see notes 1 and 3)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 3)	Type of blocking signal
(-139 dBm + 10 × log_{10}(OCBW) + 10 dB) or (-74 dBm + 10 dB) whichever is less (see note 2)	2 380 2 504 2 300 2 584	-34	CW
NOTE 1: OCBW is in Hz. NOTE 2: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to P_{min} + 26 dB where P_{min} is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal. NOTE 3: The level specified is the level at the UUT receiver input assuming a 0 dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2.			

Table 16: Receiver Blocking parameters receiver Category 3 equipment

Wanted signal mean power from companion device (dBm) (see notes 1 and 3)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 3)	Type of blocking signal
(-139 dBm + 10 × log_{10}(OCBW) + 20 dB) or (-74 dBm + 20 dB) whichever is less (see note 2)	2 380 2 504 2 300 2 584	-34	CW
NOTE 1: OCBW is in Hz. NOTE 2: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to P_{min} + 30 dB where P_{min} is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal. NOTE 3: The level specified is the level at the UUT receiver input assuming a 0 dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2.			

10.2 Measurement Procedure

ETSI EN 300 328 V2.2.2 Clause 5.4.11

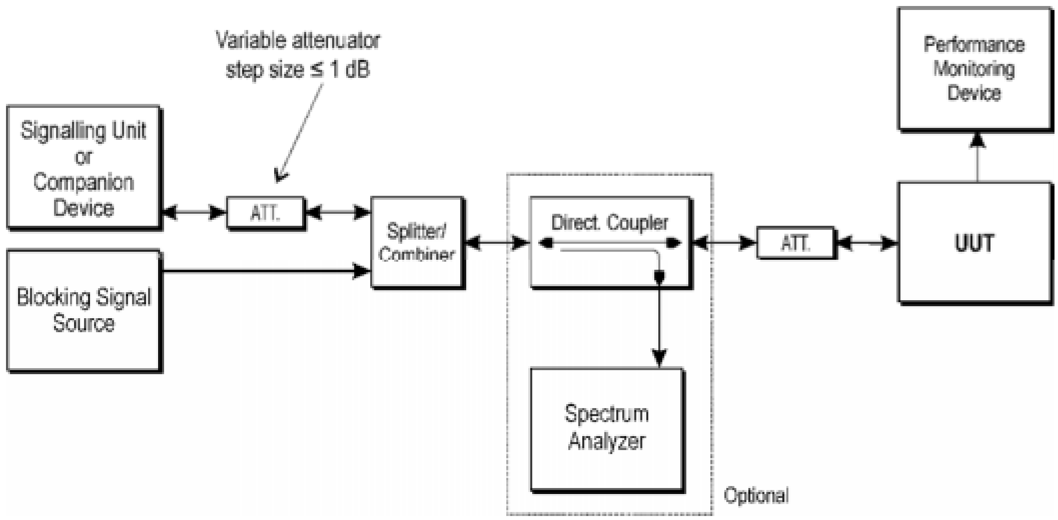


Figure 6: Test Set-up for receiver blocking

Step 1:

- For non-FHSS equipment, the UUT shall be set to the lowest operating channel on which the blocking test has to be performed (see clause 5.4.11.1).

Step 2:

- The blocking signal generator is set to the first frequency as defined in the appropriate table corresponding to the receiver category and type of equipment.

Step 3:

- With the blocking signal generator switched off, a communication link is established between the UUT and the associated companion device using the test setup shown in figure 6.
- Unless the option provided in note 2 of the applicable table referred to in clause 5.4.11.2.1 is used, the level of the wanted signal shall be set to the value provided in the table corresponding to the receiver category and type of equipment. The test procedure defined in clause 5.4.2, and more in particular clause 5.4.2.2.1.2, can be used to measure the (conducted) level of the wanted signal however no correction shall be made for antenna gain of the companion device (step 6 in clause 5.4.2.2.1.2 shall be ignored). This level may be measured directly at the output of the companion device and a correction is made for the coupling loss into the UUT. The actual level for the wanted signal shall be recorded in the test report.
- When the option provided in note 2 of the applicable table referred to in clause 5.4.11.2.1 is used, the attenuation of the variable attenuator shall be increased in 1 dB steps to a value at which the minimum performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is still met. The resulting level for the wanted signal at the input of the UUT is P_{min}. This signal level (P_{min}) is increased by the value provided in note 2 of the applicable table corresponding to the receiver category and type of equipment.

Step 4:

- The blocking signal at the UUT is set to the level provided in the table corresponding to the receiver category and type of equipment.
- If the performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 are met then proceed to step 6.

Step 5:

- If the performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is not met, step 3 and step 4 shall be repeated after that the frequency of the blocking signal set in step 2 has been increased with a value equal to the Occupied Channel Bandwidth except:
  - For the blocking frequency 2 380 MHz, where this frequency offset shall be less than or equal to 10 MHz. If this frequency offset is more than 7 MHz, the level of the wanted signal shall be increased by 3 dB.
  - For the blocking frequency 2 503,5 MHz, where this frequency offset shall be less than or equal to 10 MHz. If this frequency offset is more than 7 MHz, the level of the wanted signal shall be decreased by 3 dB.
- If the performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is still not met, step 3 and step 4 shall be repeated after that the frequency of the blocking signal set in step 2 has been decreased with a value equal to the Occupied Channel Bandwidth except:
  - For the blocking frequency 2 380 MHz, where this frequency offset shall be less than or equal to 10 MHz. If this frequency offset is more than 7 MHz, the level of the wanted signal shall be decreased by 3 dB.
  - For the blocking frequency 2 503,5 MHz, where this frequency offset shall be less than or equal to 10 MHz. If this frequency offset is more than 7 MHz, the level of the wanted signal shall be increased by 3 dB.
- If the performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is still not met, the UUT fails to comply with the Receiver Blocking requirement and step 6 and step 7 are no longer required.
- It shall be recorded in the test report whether the shift of blocking frequencies as described in the present step was used.

Step 6:

- Repeat step 4 and step 5 for each remaining combination of frequency and level for the blocking signal as provided in the table corresponding to the receiver category and type of equipment.

Step 7:

- For non-FHSS equipment, repeat step 2 to step 6 with the UUT operating at the highest operating channel on which the blocking test has to be performed (see clause 5.4.11.1).

Step 8:

- It shall be assessed and recorded in the test report whether the UUT complies with the Receiver Blocking requirement.

10.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Cycle
Rohde & Schwarz	Wideband Radio Communication Tester	CMW500	116556	Not Required	-
Mini Circuits	Combiner	15542	ZFSC-2-10G	Not Required	-
-	RF cable	-	-	Each time[1]	N/A
-	RF cable	-	-	Each time[1]	N/A
Keysight Technologies	Vector Signal Generator	N5182B	MY51350070	2021-06-22	1 Year

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".*

10.4 Environmental Conditions

Temperature:	24° C
Relative Humidity:	48 %
ATM Pressure:	101.5 kPa

The testing was performed by Christian McCaig from 2021-08-02 at RF site.

10.5 Test Results

Note: this device is adaptive unit and EIRP is higher than 10 dBm. Thus, the device is under Receiver Category 1. Please refer to below table for test result.

Operating Frequency (MHz)	Blocking Signal Frequency (MHz)	PER (Packet Error Rate)	Limit
2412	2300	0%	10%
	2330	1%	10%
	2360	0%	10%
	2380	1%	10%
2472	2504	3%	10%
	2524	5%	10%
	2584	4%	10%
	2674	6%	10%

11 EN 300 328 Clause 4.3.2.6 – Adaptivity

11.1 Applicable Standard

EN 300 328 V2.2.2 Clause 4.3.2.6.3.2.3: Load Based Equipment

Adaptivity is a mechanism used by equipment to automatically adapt to its environment by identifying frequencies that are being used by other equipment.

11.2 Measurement Procedure

Step 1:

• The UUT shall connect to a companion device during the test. The interference signal generator, the blocking signal generator, the spectrum analyser, the UUT and the companion device are connected using a set-up equivalent to the example given by figure 5 although the interference and blocking signal generator do not generate any signals at this point in time. The spectrum analyser is used to monitor the transmissions of the UUT in response to the interfering and the blocking signals.

• Adjust the received signal level (wanted signal from the companion device) at the UUT to the value defined in table 6 (clause 4).

NOTE 1: Testing of Unidirectional equipment does not require a link to be established with a companion device.

• The analyser shall be set as follows:

- RBW: ≥Occupied Channel Bandwidth (if the analyser does not support this setting, the highest available setting shall be used)

- VBW: 3 × RBW (if the analyser does not support this setting, the highest available setting shall be used)

- Detector Mode: RMS

- Centre Frequency: Equal to the centre frequency of the operating channel

- Span: 0 Hz

- Sweep time: > maximum Channel Occupancy Time

- Trace Mode: Clear Write

- Trigger Mode: Video

Step 2:

• Configure the UUT for normal transmissions with a sufficiently high payload resulting in a minimum transmitter activity ratio (TxOn / (TxOn + TxOff)) of 0,3. Where this is not possible, the UUT shall be configured to the maximum payload possible.

• For Frame Based Equipment, using the procedure defined in clause 5.3.7.2.1.4, it shall be verified that the UUT complies with the maximum Channel Occupancy Time and minimum Idle Period defined in clause 4.3.2.6.3.2.2 step 3).

• For Load Based equipment, using the procedure defined in clause 5.3.7.2.1.4, it shall be verified that the UUT complies with the maximum Channel Occupancy Time and minimum Idle Period defined in clause 4.3.2.6.3.2.3.

NOTE 2: For the purpose of testing Load Based Equipment referred to in the first paragraph of clause 4.3.2.6.3.2.3 (IEEE 802.11™ [i.3] or IEEE 802.15.4™ [i.4] equipment), the limits to be applied for the minimum Idle Period and the maximum Channel Occupancy Time are the same as defined for other types of Load Based Equipment (see clause 4.3.2.6.3.2.3 step 2) and step 3). The Idle Period is considered to be equal to the CCA or Extended CCA time defined in clause 4.3.2.6.3.2.3 step 1) and step 2).

Step 3: Adding the interference signal

An interference signal as defined in clause B.6 is injected on the current operating channel of the UUT. The power spectral density level (at the input of the UUT) of this interference signal shall be equal to the detection threshold defined in clause 4.3.2.6.3.2.2 step 5) (frame based equipment) or clause 4.3.2.6.3.2.3 step 5) (load based equipment).

Step 4: Verification of reaction to the interference signal

• The spectrum analyser shall be used to monitor the transmissions of the UUT on the selected operating channel with the interfering signal injected. This may require the spectrum analyser sweep to be triggered by the start of the interfering signal.

• Using the procedure defined in clause 5.3.7.2.1.4, it shall be verified that:

i) The UUT shall stop transmissions on the current operating channel.

NOTE 3: The UUT is assumed to stop transmissions within a period equal to the maximum Channel Occupancy Time defined in clause 4.3.2.6.3.2.2 (frame based equipment) or clause 4.3.2.6.3.2.3 (load based equipment).

ii) Apart from Short Control Signalling Transmissions, there shall be no subsequent transmissions while the interfering signal is present.

NOTE 4: To verify that the UUT is not resuming normal transmissions as long as the interference signal is present, the monitoring time may need to be 60 s or more.

iii) The UUT may continue to have Short Control Signalling Transmissions on the operating channel while the interfering signal is present. These transmissions shall comply with the limits defined in clause 4.3.2.6.4.2.

NOTE 5: The verification of the Short Control Signalling transmissions may require the analyser settings to be changed (e.g. sweep time).

iv) Alternatively, the equipment may switch to a non-adaptive mode.

Step 5: Adding the blocking signal

• With the interfering signal present, a 100 % duty cycle CW signal is inserted as the blocking signal. The frequency and the level are provided in table 6 of clause 4.3.2.11.3.

• The spectrum analyser shall be used to monitor the transmissions of the UUT on the selected operating channel. This may require the spectrum analyser sweep to be triggered by the start of the blocking signal.

• Using the procedure defined in clause 5.3.7.2.1.4, it shall be verified that:

i)The UUT shall not resume normal transmissions on the current operating channel as long as both the interference and blocking signals remain present.

NOTE 6: To verify that the UUT is not resuming normal transmissions as long as the interference and blocking signals are present, the monitoring time may need to be 60 s or more.

ii) The UUT may continue to have Short Control Signalling Transmissions on the operating channel while the interfering and blocking signals are present. These transmissions shall comply with the limits defined in clause 4.3.2.6.4.2.

NOTE 7: The verification of the Short Control Signalling transmissions may require the analyser settings to be changed (e.g. sweep time).

Step 6: Removing the interference and blocking signal

• On removal of the interference and blocking signal the UUT is allowed to start transmissions again on this channel however this is not a requirement and therefore does not require testing.

Step 7:

• Step 2 to step 6 shall be repeated for each of the frequencies to be tested.

11.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Cycle
Rohde & Schwarz	Wideband Radio Communication Tester	CMW500	116556	Not Required	-
Agilent	EXA Signal Analyzer	N9010A	MY48030852	2020-02-12	19 months
Keysight	Vector Signal Generator	N5182B	MY51350070	2021-06-22	1 year
Agilent	Signal Generator	E4438C	MY45091309	2021-05-18	1 year
Tonscend	JS1120-3 Measurement Software	-	-	-	-

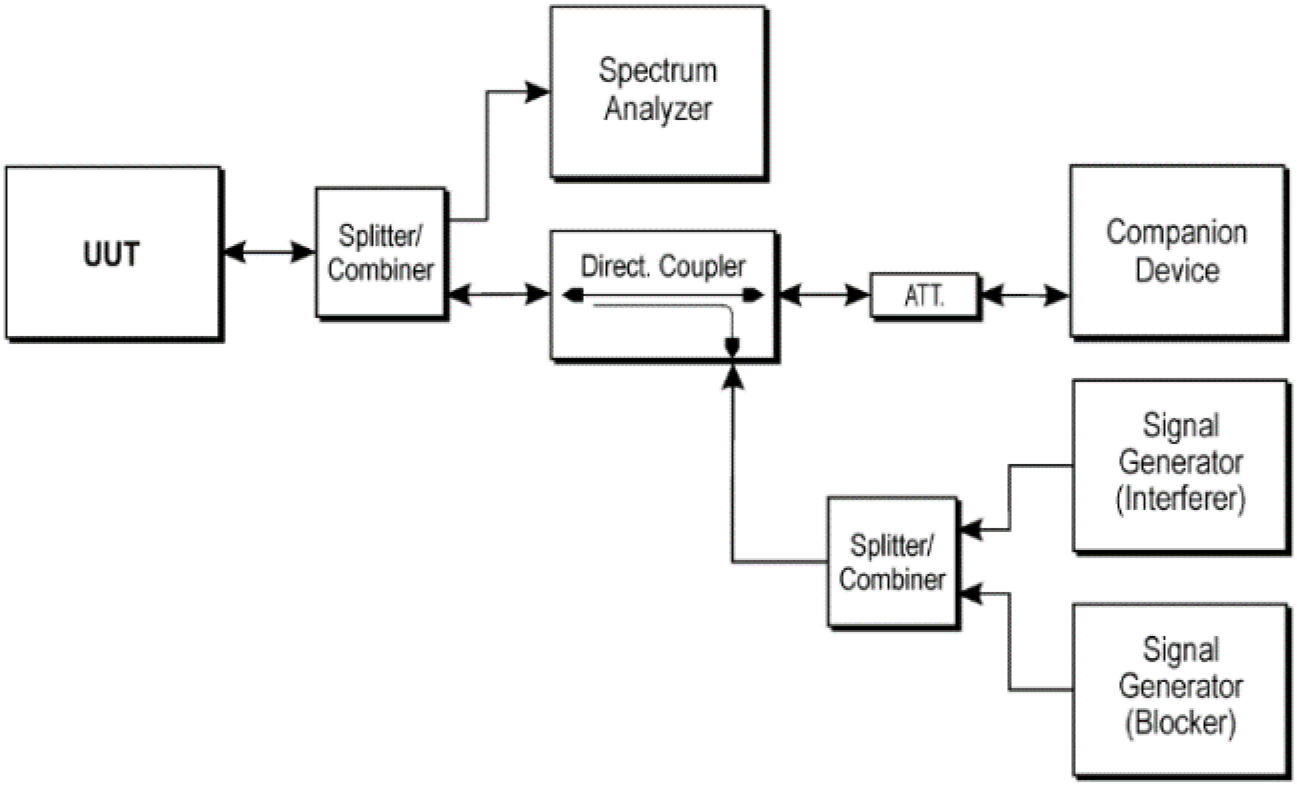
Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".*

11.4 Environmental Conditions

Temperature:	23.9º C
Relative Humidity:	46 %
ATM Pressure:	100.9 kPa

The testing was performed by Simon Ma on 2021-08-16 at RF site.

11.5 Test Setup Block Diagram

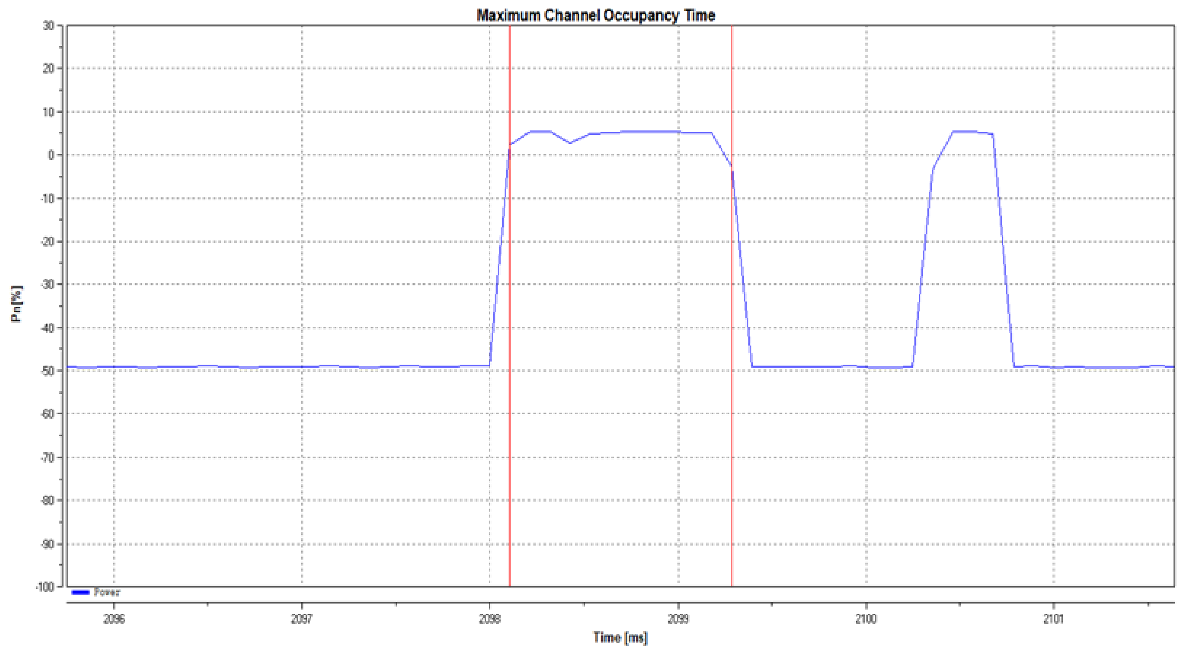


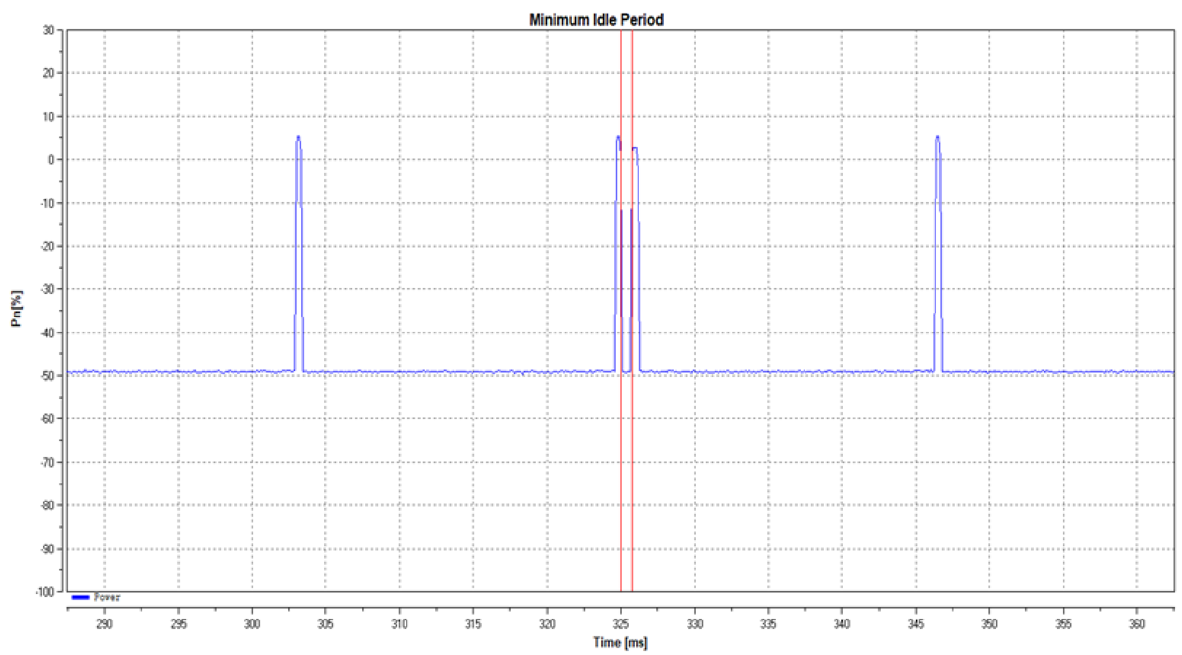
11.6 Test Results

Test Mode	Antenna	Channel	Max.COT [ms]	Limit[ms]	Min.Idel Time[ms]	Limit[ms]	Verdict
11B	Ant1	2412	1.178	13	0.751	0.018	PASS
		2472	1.178	13	0.319	0.018	PASS

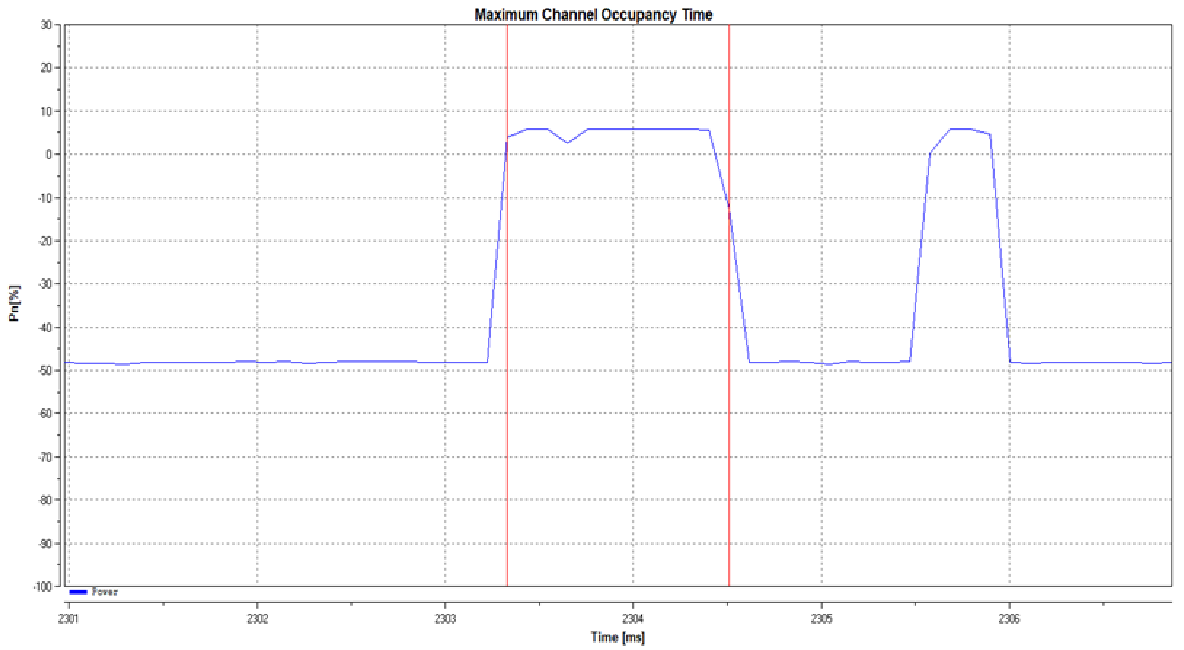
Test Mode	Antenna	Channel	Add Signal Type	Add Signal Level [dBm]	Max. Short Time [%]	Limit [%]	Verdict
11B	Ant1	2412	AWGN	-66.00	0.58	10	PASS
			CW	-31.00	0.58	10	PASS
		2472	AWGN	-66.00	0.00	10	PASS
			CW	-31.00	0.00	10	PASS

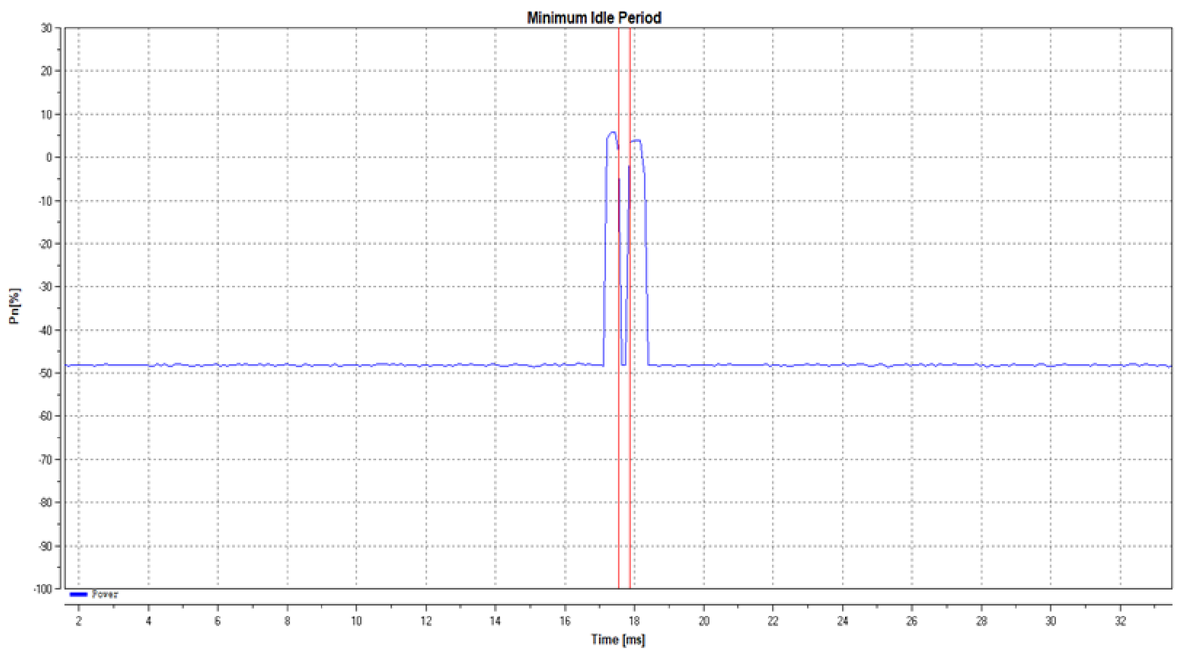
11B_Ant1_2412



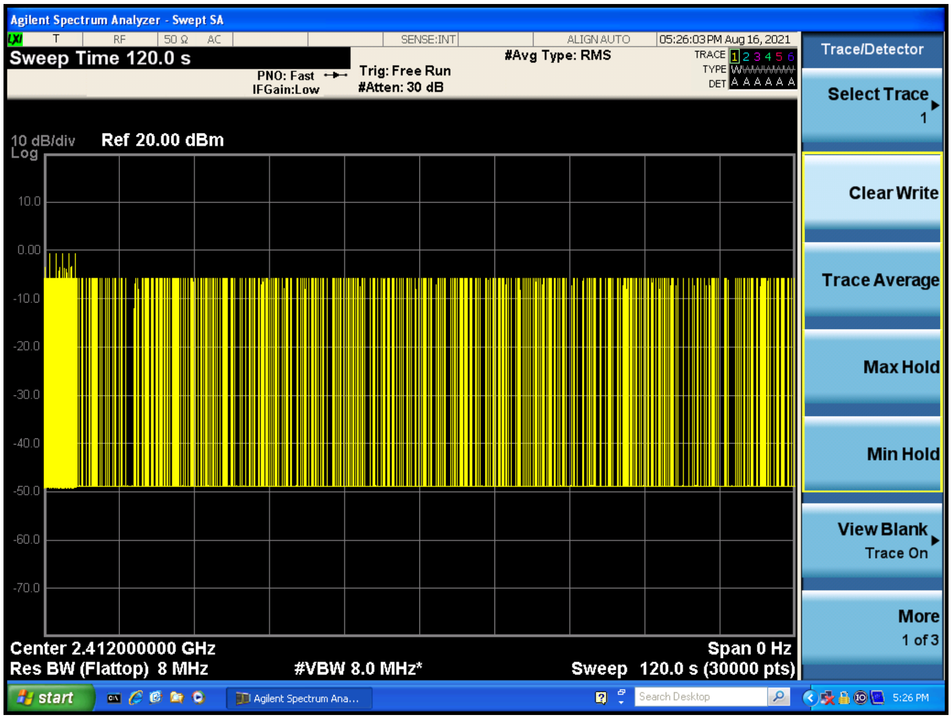


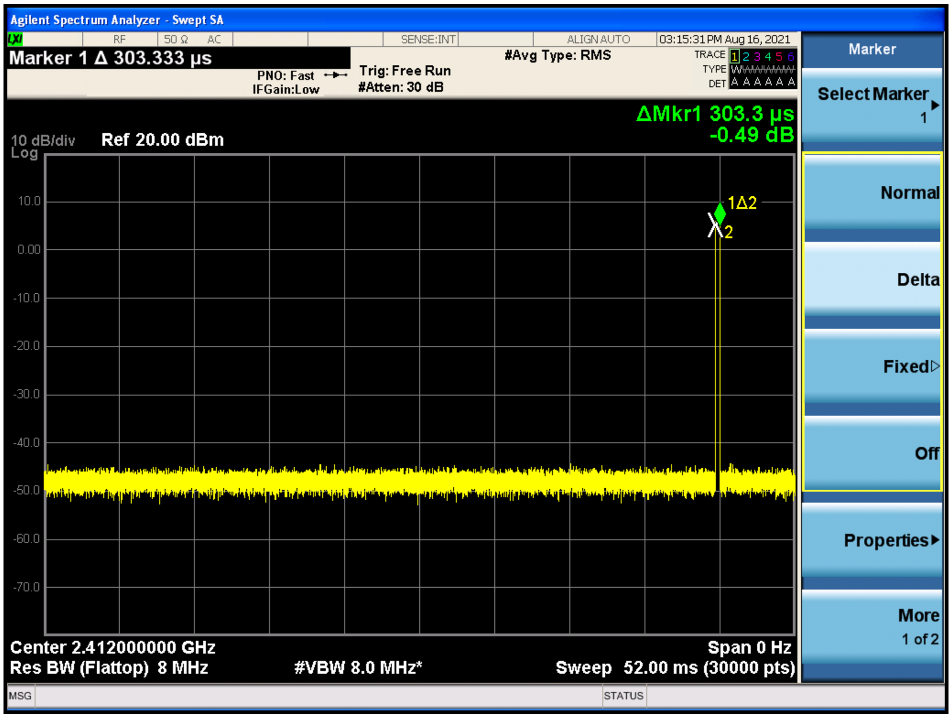
11B_Ant1_2472



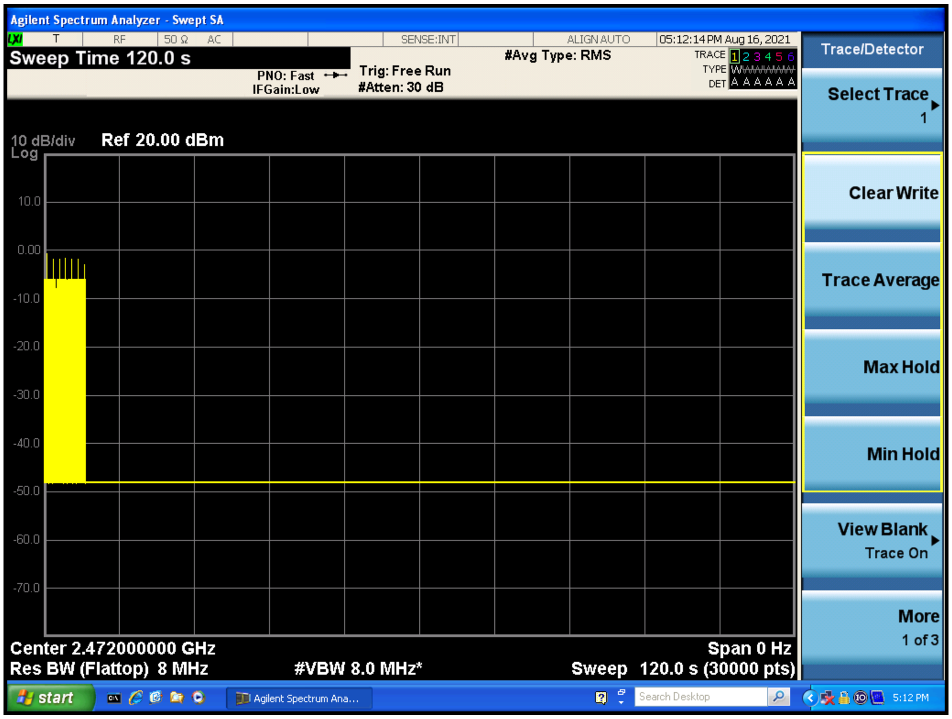


11B_Ant1_2412





11B_Ant1_2472



12 EN 300 328 Clause 4.3.2.12 – Geo-location capability

12.1 Applicable Standard

Geo-location capability is a feature of the RLAN device to determine its geographical location with the purpose to configure itself according to the regulatory requirements applicable at the geographical location where it operates.

The geo-location capability may be present in the equipment or in an external device (temporary) associated with the equipment operating at the same geographical location during the initial power up of the equipment. The geographical location may also be available in equipment already installed and operating at the same geographical location.

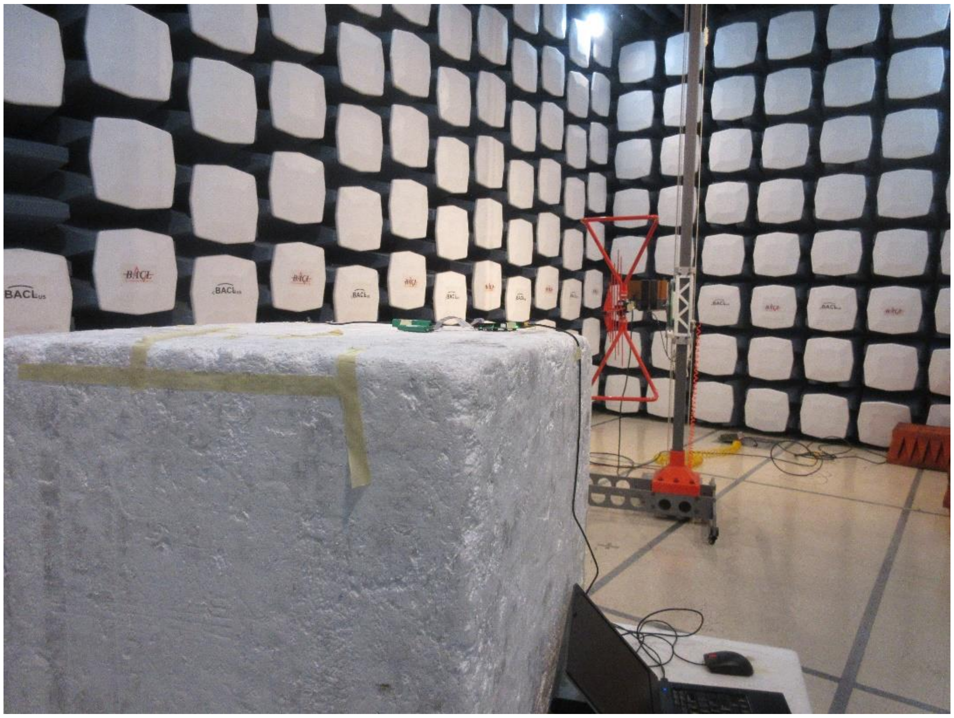
12.2 Test Results

Manufacturer declares this unit does not have Geo-location capability.

13 Annex A (Normative) – UUT Test Setup Photographs

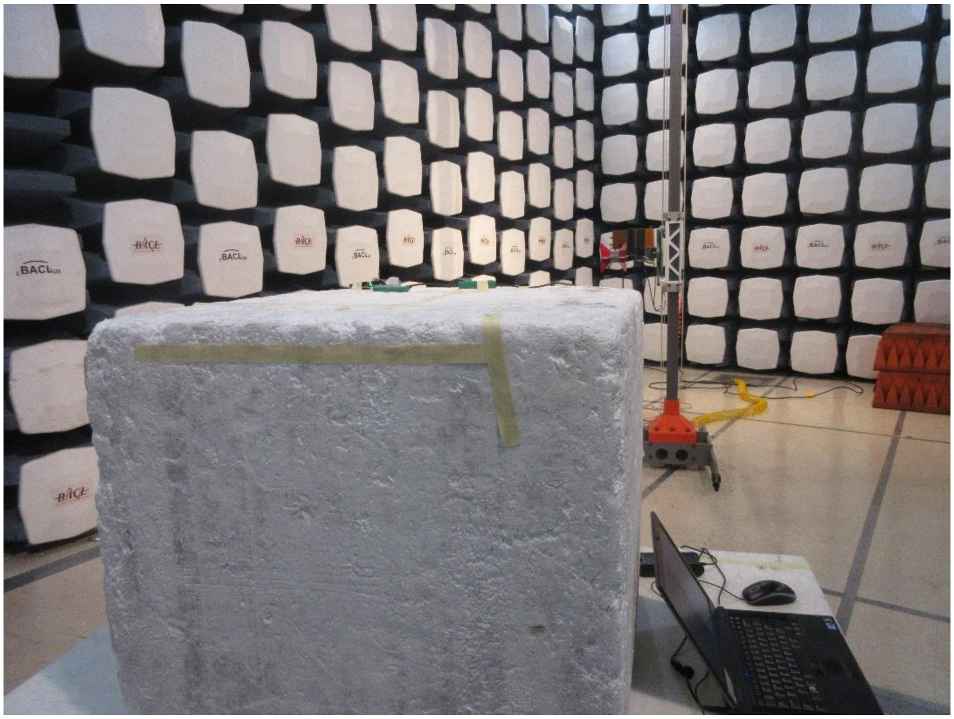
13.1 Radiated Emission below 1 GHz Front View

13.2 Radiated Emission below 1 GHz Rear View



13.3 Radiated Emission above 1 GHz Front View

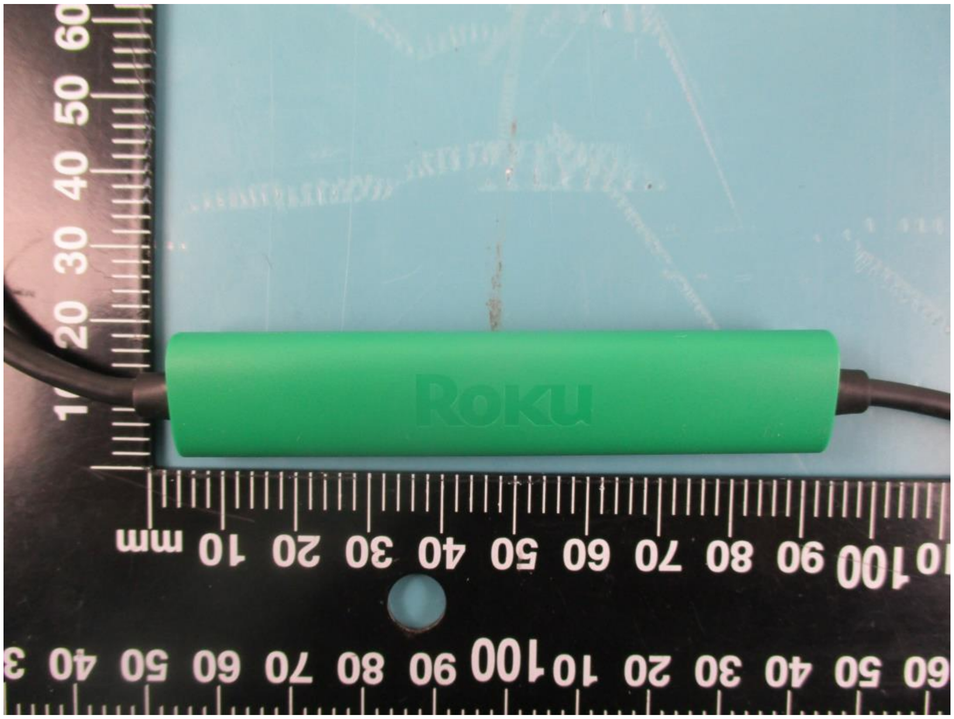
13.4 Radiated Emission above 1 GHz Rear View



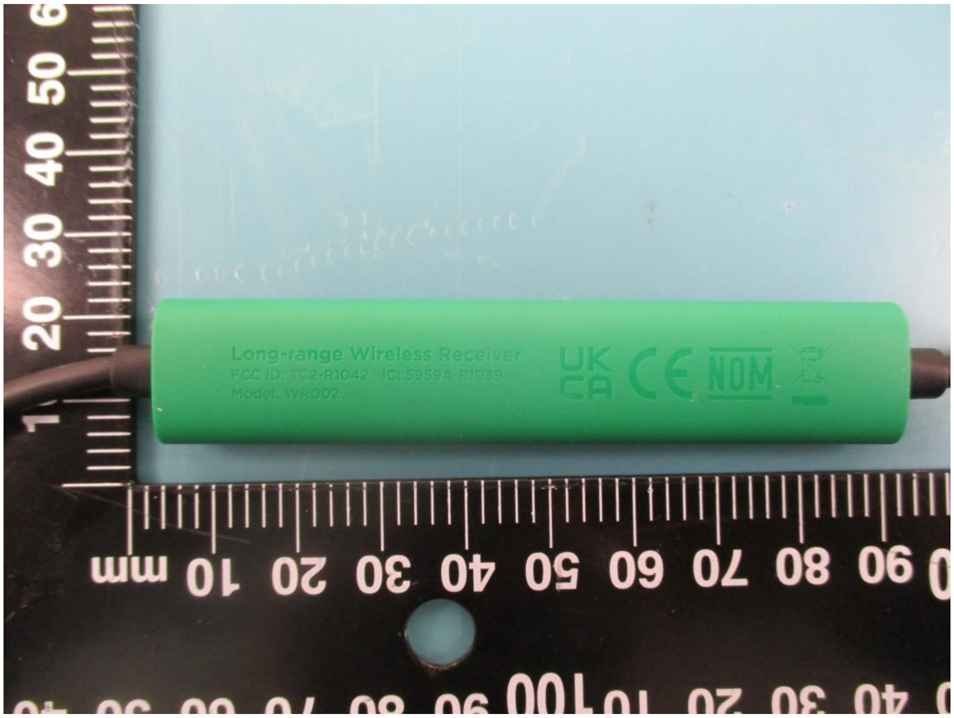
14 Annex B (Normative) – UUT Photographs

14.1 UUT – 3820X with WR002

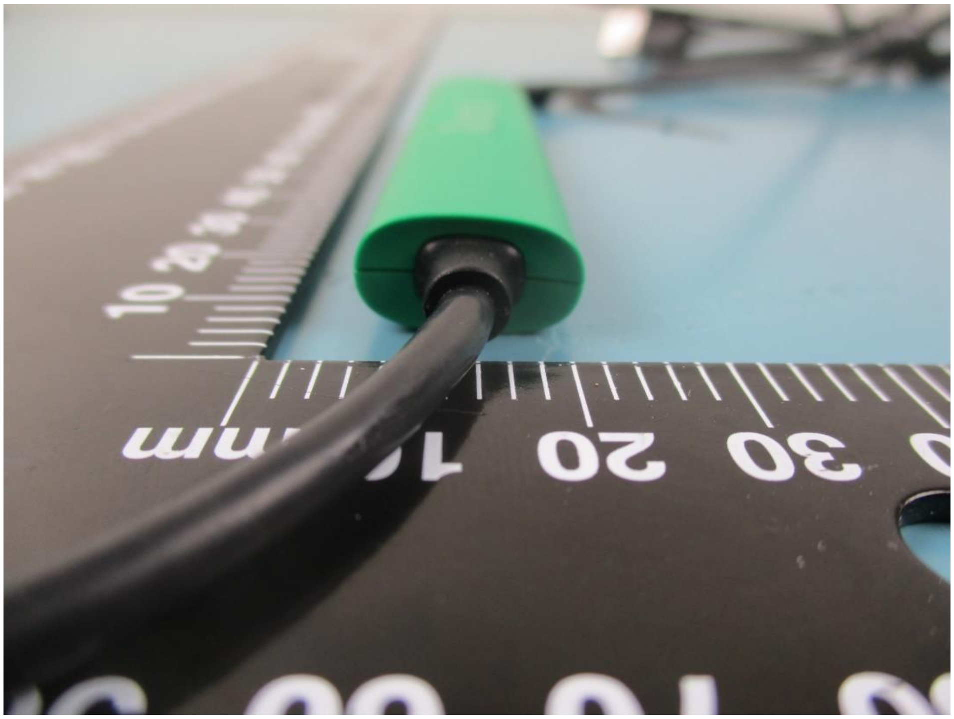
14.2 UUT – WR002 (Top View)



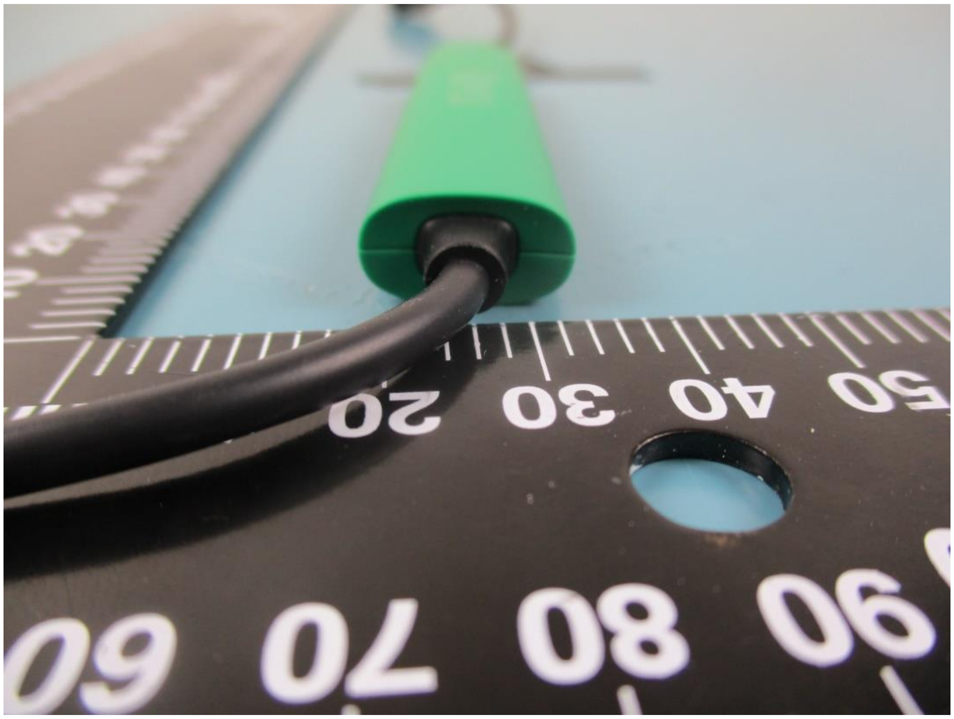
14.3 UUT – WR002 (Bottom View)



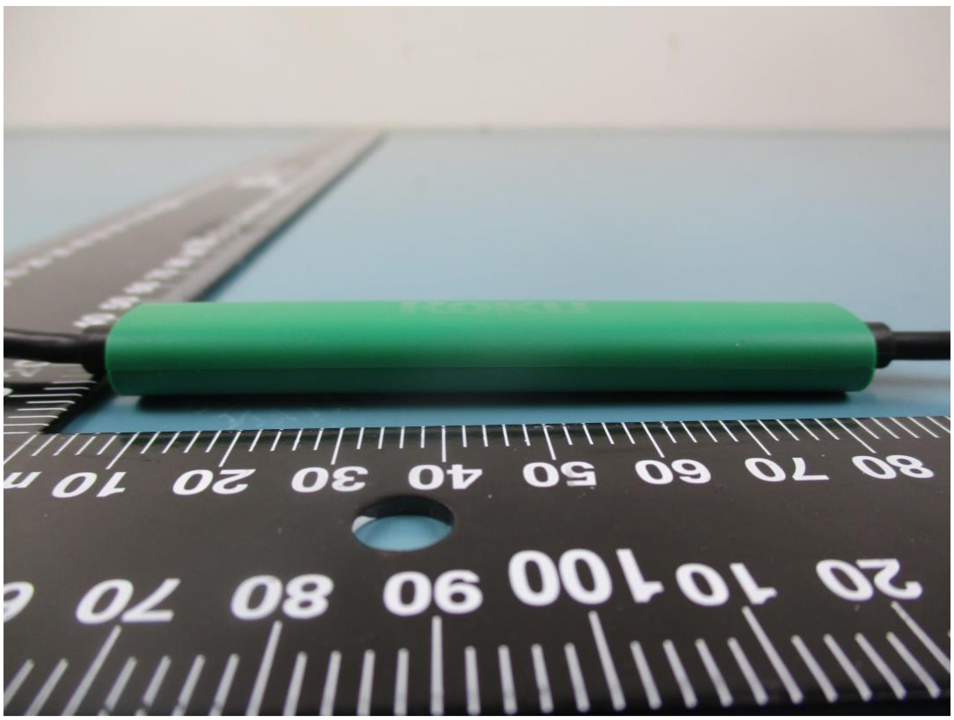
14.4 UUT – WR002 (Left View)



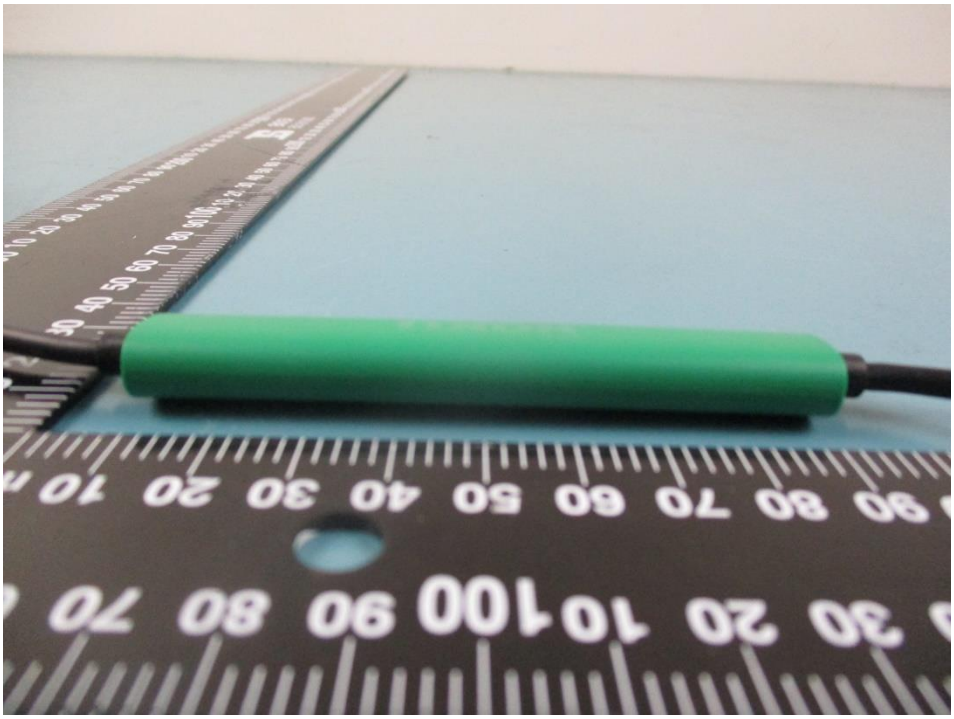
14.5 UUT – WR002 (Right View)



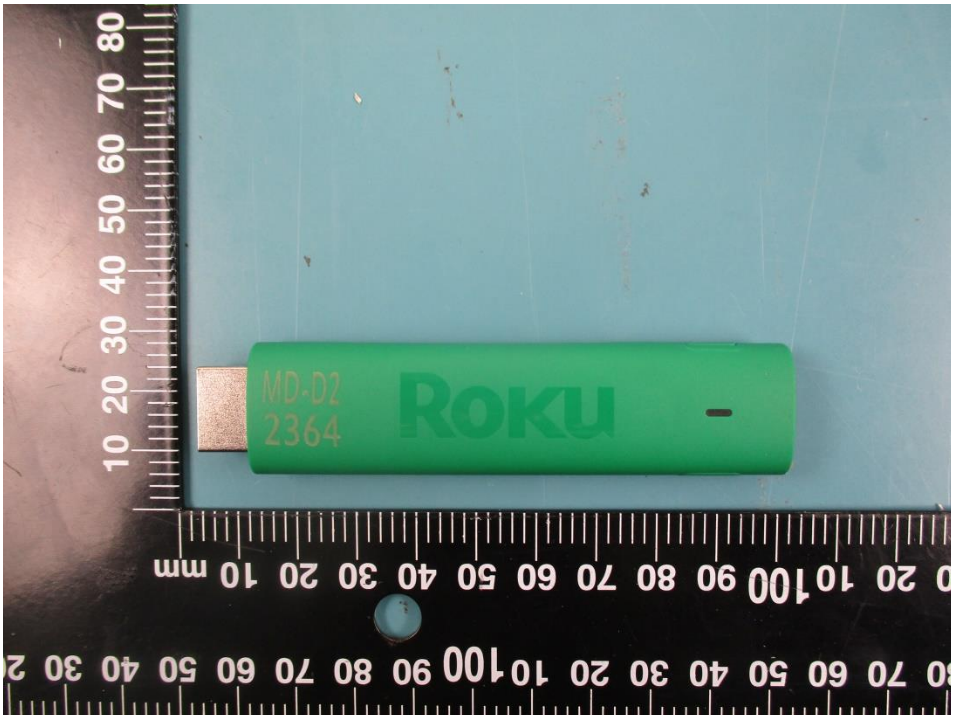
14.6 UUT – WR002 (Front View)



14.7 UUT – WR002 (Rear View)

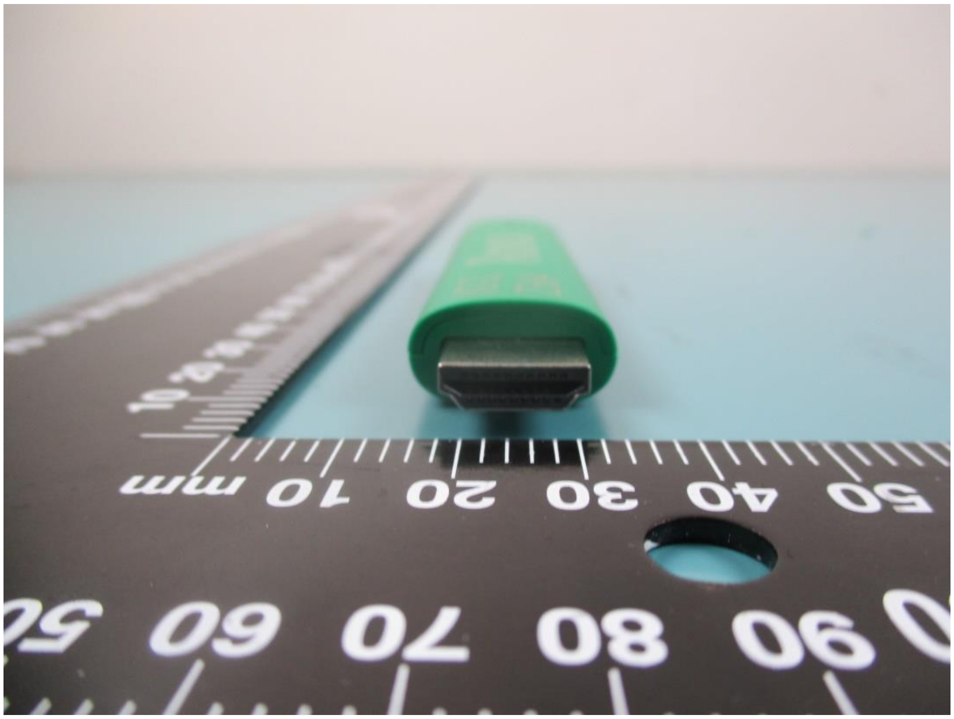


14.8 UUT – 3820X (Top View)

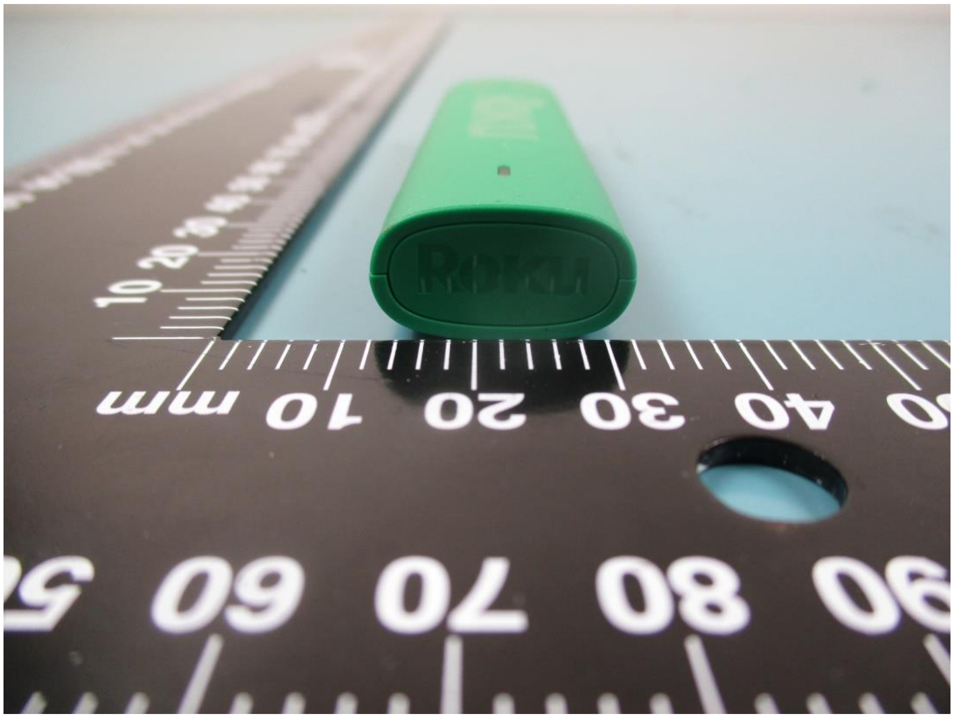


14.9 UUT – 3820X (Bottom View)

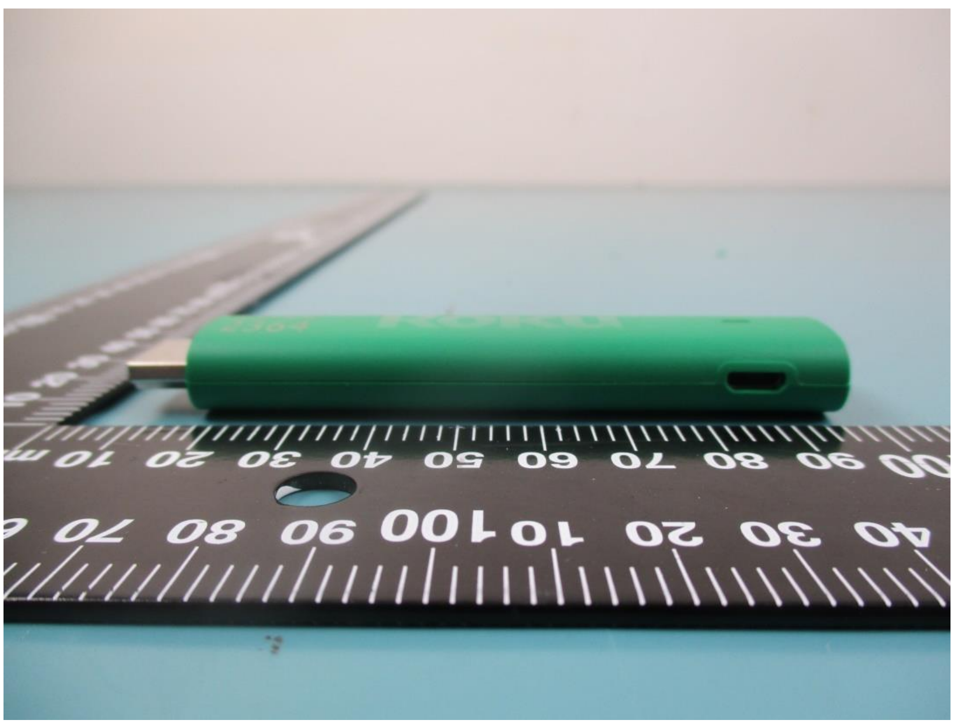
14.10 UUT – 3820X (Left View)



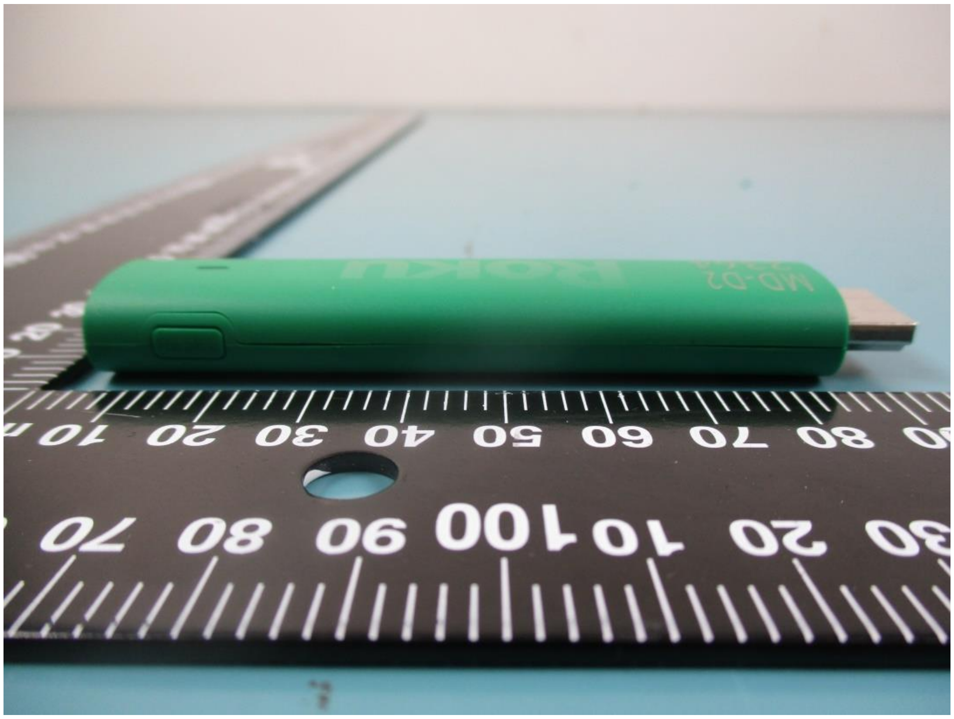
14.11 UUT – 3820X (Right View)



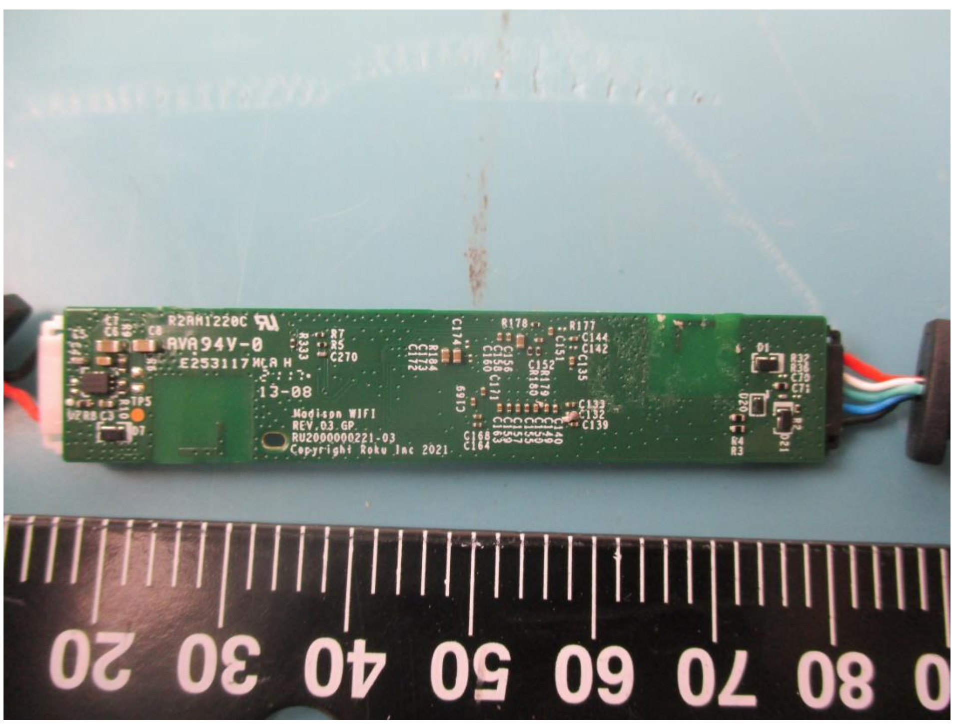
14.12 UUT – 3820X (Front View)



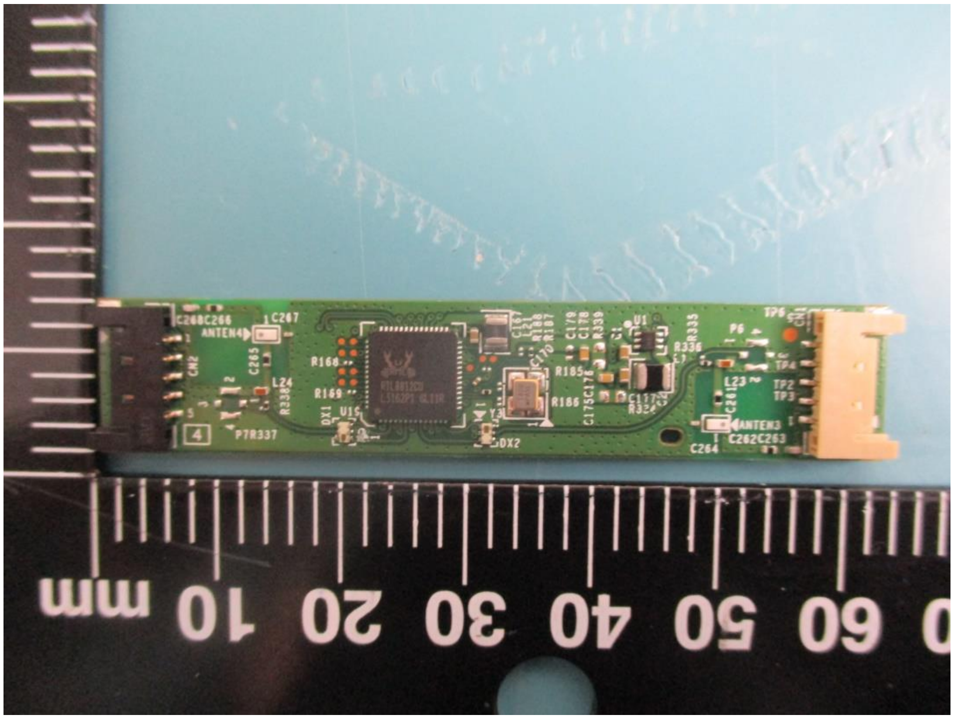
14.13 UUT – 3820X (Rear View)



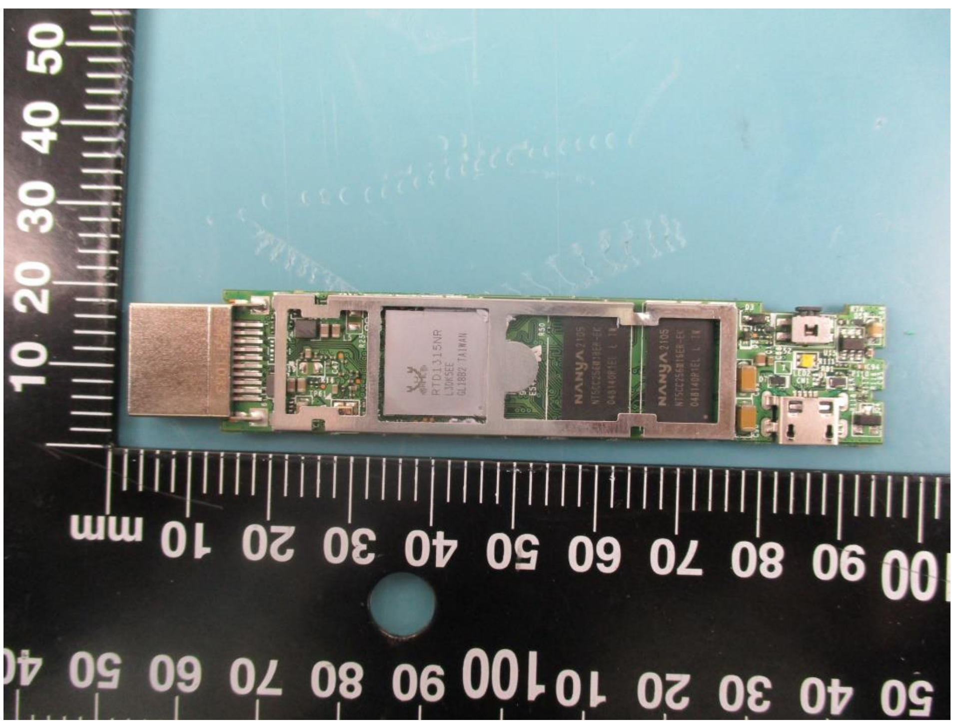
14.14 UUT – WR002 (Internal Top View)



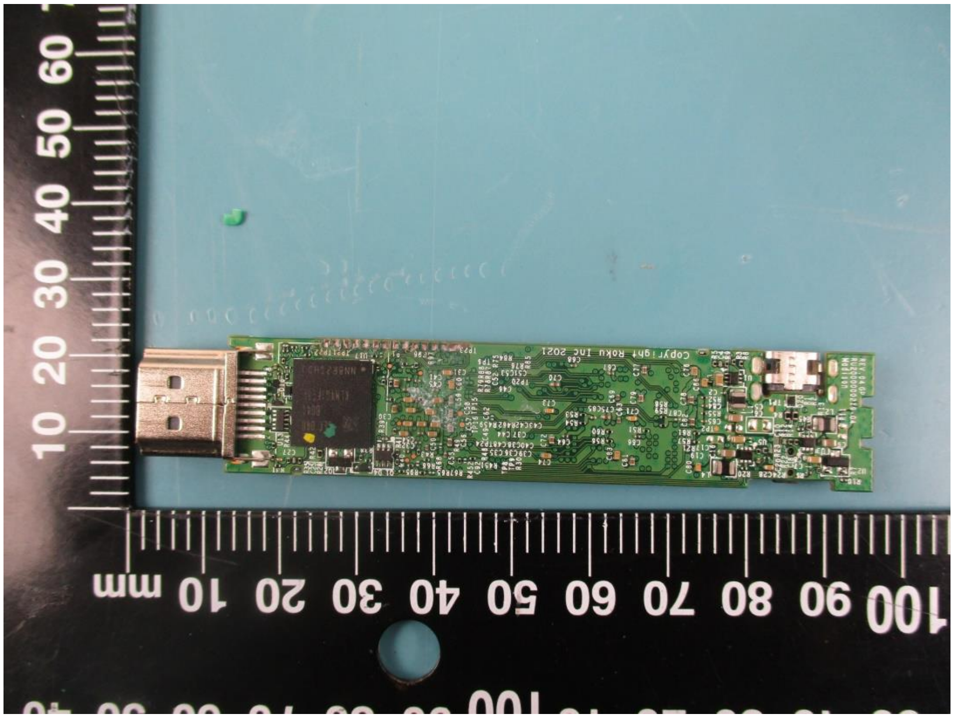
14.15 UUT – WR002 (Internal Bottom View)



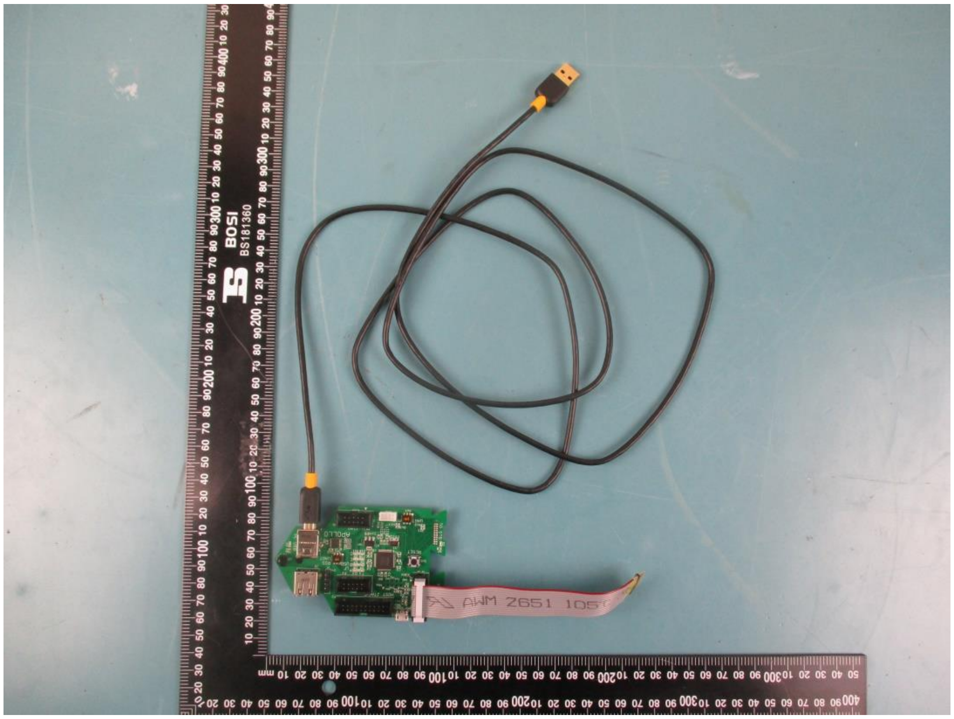
14.16 UUT – 3820X (Internal Top View)



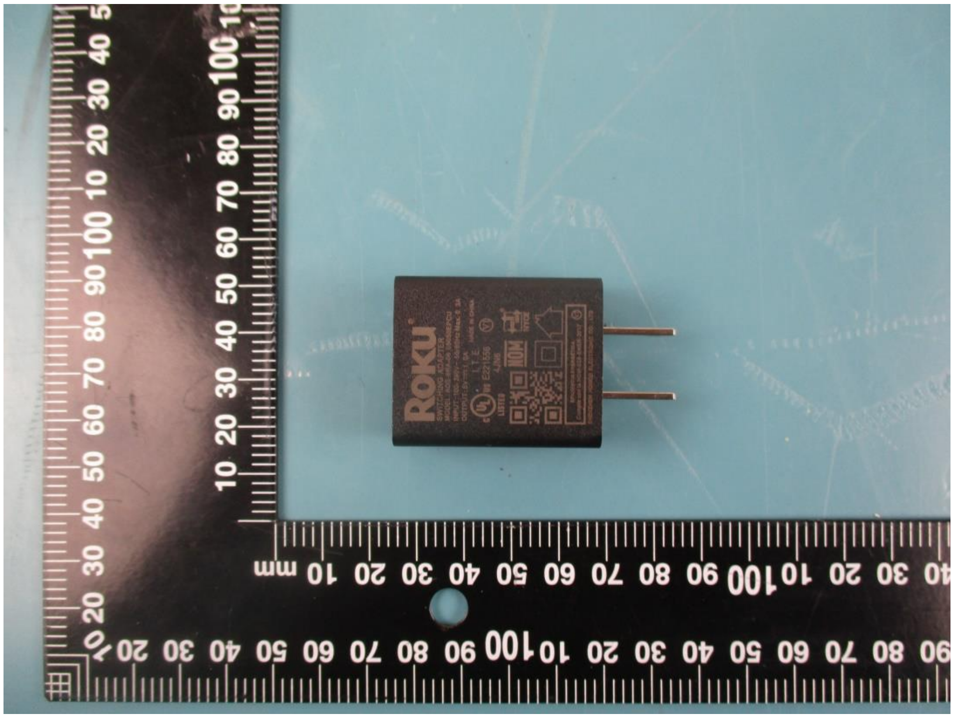
14.17 UUT – 3820X (Internal Bottom View)



14.18 Support Equipment – Debug Board and Cables



14.19 Support Equipment – Charging Block



15 Annex C (Informative) – Manufacturer's Declaration of Similarity (DoS)

Roku, Inc. 1155 Coleman Ave. San Jose, CA 95110 USA

DECLARATION OF SIMILARITY

August 10, 2022

To:
Bay Area Compliance Laboratories Corp.
1274 Anvilwood Ave.
Sunnyvale, CA 94089
Phone: 408-732-9162, Fax: 408-732-9164
http://www.baclcorp.com

Dear Sir or Madam:

We *Roku, Inc.* hereby declare the following hardware similarities between the product: *Streaming player*, models 3820X, 3821X, 3820X2, and 3821X2.

Model	**Hardware Similarities**	**BACL Project Reference**
3820X	Original	R2106181 R2108088 R2108244
3821X	Identical to 3820X. The only different between the model names is to represent a different remote-control unit bundled with the end-product. The remote-control units have been separately certified under FCC ID: TC2-R1041 (bundled with 3820X) and FCC ID: TC2-R1039 (bundled with 3821X)	
3820X2	Identical to 3820X only in enclosure design. Ships with identical wireless receiver model WR002 as 3820X.	R2205317
3821X2	Identical to 3820X2. The only difference between the model names is to represent a different remote-control unit bundled with the end-product. The remote-control units have been separately certified under FCC ID: TC2-R1047 (bundled with 3820X2) and FCC ID: TC2-R1039 (bundled with 3821X2)	

Please contact me should there be need for any additional clarification or information.

Best Regards,

Robert Curtis, Sr. Director, SW Engineering
1155 Coleman Ave. San Jose, CA 95110 USA
RCurtis@roku.com

QA-FR-227-A 11/05/2013

16 Annex C (Normative) - A2LA Electrical Testing Certificate

Accredited Laboratory

A2LA has accredited

BAY AREA COMPLIANCE LABORATORIES CORP.

Sunnyvale, CA

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets A2LA *R222 - Specific Requirements EPA ENERGY STAR Accreditation Program*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated April 2017*).

Presented this 10th day of March 2021.

Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 3297.02
Valid to September 30, 2022

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

Please follow the web link below for a full ISO 17025 scope

https://www.a2la.org/scopepdf/3297-02.pdf

--- END OF REPORT ---