



427 West 12800 South
Draper, UT 84020

Test Report Certification

FCC ID	SWX-LBEAX
ISED ID	6545A-LBEAX
Equipment Under Test	LBE-AX
Test Report Serial Number	TR6451_01
Date of Tests	10, 28 January; 1-2 February 2022
Report Issue Date	28 April 2022

Test Specification	Applicant
47 CFR FCC Part 15, Subpart E	Ubiquiti Inc. 685 Third Avenue New York, NY 10017 U.S.A.



NVLAP LAB CODE 600241-0

Certification of Engineering Report

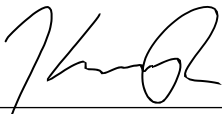
This report has been prepared by Unified Compliance Laboratory (UCL) to document compliance of the device described below with the requirement of Federal Communication Commissions (FCC) Part 15, Subpart E. This report may be reproduced in full. Partial reproduction of this report may only be made with the written consent of the laboratory. The results in this report apply only to the sample tested.

Applicant	Ubiquiti Inc.
Manufacturer	Ubiquiti Inc.
Brand Name	airMAX
Model Number	LBE-AX
FCC ID	SWX-LBEAX
ISED ID	6545A-LBEAX

On this 28 day of April 2022, I individually and for Unified Compliance Laboratory certify that the statements made in this engineering report are true, complete and correct to the best of my knowledge and are made in good faith.

Although NVLAP has accredited the Unified Compliance Laboratory testing facilities, this report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the U.S. federal government.

Unified Compliance Laboratory



Written By: Kimberly Rodriguez



Reviewed By: Alex Macon

Revision History		
Revision	Description	Date
01	Original Report Release	29 April 2022

Table of Contents

1	Client Information	6
1.1	Applicant.....	6
1.2	Manufacturer.....	6
2	Equipment Under Test (EUT)	7
2.1	Identification of EUT.....	7
2.2	Description of EUT.....	7
2.3	EUT and Support Equipment.....	8
2.4	Interface Ports on EUT	8
2.5	Operating Environment	8
2.6	Operating Modes	8
2.7	EUT Exercise Software	9
2.8	Block Diagram of Test Configuration	9
2.9	Modification Incorporated/Special Accessories on EUT	9
2.10	Deviation, Opinions Additional Information or Interpretations from Test Standard	9
3	Test Specification, Method and Procedures	10
3.1	Test Specification	10
3.2	Methods & Procedures	10
3.3	FCC Part 15, Subpart E	10
3.4	Results.....	10
3.5	Test Location	11
4	Test Equipment.....	12
4.1	Conducted Emissions at Mains Ports	12
4.2	Direct Connect at the Antenna Port Tests.....	12
4.3	Radiated Emissions.....	13
4.4	Equipment Calibration.....	14
4.5	Measurement Uncertainty.....	14
5	Test Results.....	15
5.1	§15.203 Antenna Requirements.....	15
5.2	Conducted Emissions at Mains Ports Data.....	15
5.3	§15.403(i) 26 dB Emissions Bandwidth.....	17
5.4	§15.407(a)(3) Maximum Average Output Power.....	18
5.5	§15.407(b)(7) Spurious Emissions	19
5.6	§15.407(a) Maximum Power Spectral Density	22

1 Client Information

1.1 Applicant

Company	Ubiquiti Inc. 685 Third Avenue New York, NY 10017 U.S.A.
Contact Name	Mark Feil
Title	Compliance Manager

1.2 Manufacturer

Company	Ubiquiti Inc. 685 Third Avenue New York, NY 10017 U.S.A.
Contact Name	Mark Feil
Title	Compliance Manager

2 Equipment Under Test (EUT)

2.1 Identification of EUT

Brand Name	airMAX
Model Number	LBE-AX
Serial Number	68D79A1FA536
Dimensions (cm)	35.8 x 27.2 x 27.3

2.2 Description of EUT

The LBE-AX is a point-to-point transceiver intended for outdoor use and operating in the 5 GHz WiFi, UNII-1, UNII-2A/2C and UNII-3 frequency bands. The 5 GHz WiFi is a 2x2 radio with cross polarized elements. The LBE-AX is designed to be lightweight and aimed to create extremely long-distance wireless links. The LBE-AX also has a Bluetooth LE transceiver for device management. An Ethernet port is used for data transfer and to provide power using a POE-24V-24W POE power adapter.

The table below show the channels used within the different modulation bandwidths.

Band	WiFi Mode	Modulation Bandwidth	Modulation Type	Frequency (MHz)
UNII-3	ax	20 MHz	HE	5740, 5790, 5835
	ax	40 MHz	HE	5750, 5790, 5825
	ax	80 MHz	HE	5770, 5790, 5805

This report covers the circuitry of the device subject to FCC Part 15, Subpart E. The circuitry of the device subject to FCC Part 15 Subpart B was found to be compliant and is covered under a separate Unified Compliance Laboratory test report.

2.3 EUT and Support Equipment

The EUT and support equipment used during the test are listed below.

Brand Name Model Number Serial Number	Description	Name of Interface Ports / Interface Cables
BN: airMAX MN: LBE-AX (Note 1) SN: 68D79A1FA536	Wireless Transceiver	See Section 2.4
BN: Ubiquiti Inc. MN: POE-24-24W (Note 1) SN: None	POE Supply	POE Port See Section 2.4
BN: Dell MN: XPS 13 SN: None	Laptop PC	LAN Port / Shielded or Unshielded Cat 5e cable (Note 2)

Notes: (1) EUT

(2) Interface port connected to EUT (See Section 2.4)

The support equipment listed above was not modified in order to achieve compliance with this standard.

2.4 Interface Ports on EUT

Name of Ports	# of Ports Fitted to EUT	Cable Description/Length
AC (PoE Injector)	1	3 conductor power cord/80cm
LAN (PoE Injector)	1	Shielded or Unshielded Cat 5e cable/1 meter
Data	1	Shielded or Unshielded Cat 5e cable/8meters

2.5 Operating Environment

Power Supply	120 Vac to 24 Volts PoE Power
AC Mains Frequency	60 Hz
Temperature	22.9-23.4 °C
Humidity	16.4-19.4 %
Barometric Pressure	1023 mBar

2.6 Operating Modes

The LBE-AX was tested using test software in order to enable a constant transmission. The measurements within this report are corrected to reference a 100% duty cycle. All emission modes of 802.11 ax were investigated. All measurements are reported with the worst-case mode (802.11ax) unless otherwise stated.

2.7 EUT Exercise Software

EUT firmware version 1.0 was used to operate the transmitter using a constant transmit mode.

2.8 Block Diagram of Test Configuration

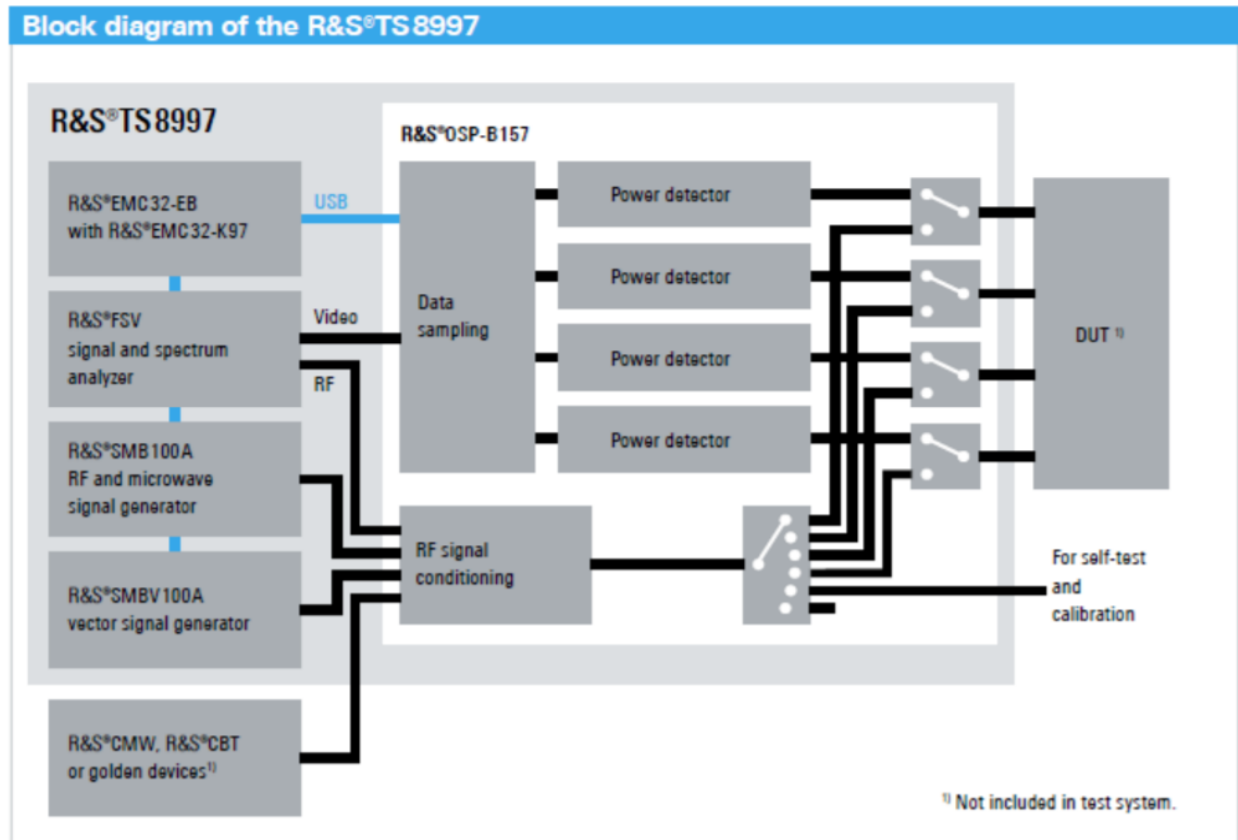


Diagram 1: Test Configuration Block Diagram

2.9 Modification Incorporated/Special Accessories on EUT

There were no modifications made to the EUT during testing to comply with the specification.

2.10 Deviation, Opinions Additional Information or Interpretations from Test Standard

There were no deviations, opinions, additional information or interpretations from the test specification.

3 Test Specification, Method and Procedures

3.1 Test Specification

Title	47 CFR FCC Part 15, Subpart E, Section 15.407 Limits and methods of measurement of radio interference characteristics of Unlicensed National Information Infrastructure Devices
Purpose of Test	The tests were performed to demonstrate initial compliance

3.2 Methods & Procedures

3.2.1 47 CFR FCC Part 15 Section 15.407

See test standard for details.

3.3 FCC Part 15, Subpart E

3.3.1 Summary of Tests

FCC Section	ISED Section	Environmental Phenomena	Frequency Range (MHZ)	Result
15.407(a)	N/A	Antenna requirements	Structural Requirement	Compliant
15.407(b)	RSS-Gen	Conducted Disturbance at Mains Port	0.15 to 30	Compliant
15.407(c)	RSS-247 §6.2.2, §6.2.3	Bandwidth Requirement	5740 to 5835	Compliant
15.407(e)	RSS-247 §6.2.2, §6.2.3	Peak Output Power	5740 to 5835	Compliant
15.407(f)	RSS-247 §6.2.2, §6.2.3	Antenna Conducted Spurious Emissions	0.009 to 40000	N/A
15.407(g)	RSS-247 §6.2.2, §6.2.3	Radiated Spurious Emissions	30 to 40000	Compliant
15.407(h)	RSS-247 §6.2.2, §6.2.3	Peak Power Spectral Density	5740 to 5835	Compliant

The testing was performed according to the procedures in ANSI C63.10-2013, KDB 789033 and 47 CFR Part 15. Where applicable, KDB 662911 was followed to sum required measurements.

3.4 Results

In the configuration tested, the EUT complied with the requirements of the specification.

3.5 Test Location

Testing was performed at the Unified Compliance Laboratory 3-meter and 10-meter chamber located at 427 West 12800 South, Draper, UT 84020. Unified Compliance Laboratory is accredited by National Voluntary Laboratory Accreditation Program (NVLAP); NVLAP Code 600241-0 which is effective until 30 June 2022. This site has also been registered with Innovations, Science and Economic Development (ISED) department as was accepted under Appendix B, Phase 1 procedures of the APEC Tel MRA for Canadian recognition. ISED No.: 25346, effective until 30 June 2022. Unified Compliance Laboratory has been assigned Conformity Assessment Number US0223 by ISED.

4 Test Equipment

4.1 Conducted Emissions at Mains Ports

Type of Equipment	Manufacturer	Model Number	Asset Number	Date of Last Calibration	Due Date of Calibration
EMI Receiver	AFJ	FFT3010	UCL-6754	12/8/2021	12/8/2022
LISN	AFJ	LS16C/10	UCL-6749	12/6/2021	12/6/2023
Cat6 ISN	Teseq	ISN T8-Cat6	UCL-2971	1/30/2022	1/30/2023
ISN	Teseq	ISN T800	UCL-2974	6/4/2021	6/4/2022
LISN	Com-Power	LIN-120C	UCL-2612	1/6/2022	1/6/2023
AC Power Source	Laplace Instruments	AC1000A	UCL-2857	N/A	N/A
Test Software	UCL	Revision 1	UCL-3107	N/A	N/A

Table 1: List of equipment used for Conducted Emissions Testing at Mains Port

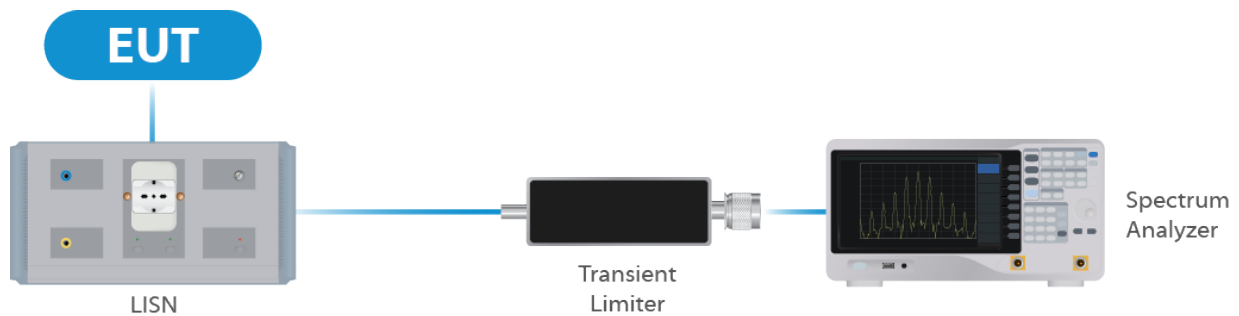


Figure 1: Conducted Emissions Test

4.2 Direct Connect at the Antenna Port Tests

Type of Equipment	Manufacturer	Model Number	Asset Number	Date of Last Calibration	Due Date of Calibration
Spectrum Analyzer	R&S	FSV40	UCL-2861	1/03/2022	1/03/2023
Signal Generator	R&S	SMB100A	UCL-2864	N/A	N/A
Vector Signal Generator	R&S	SMBV100A	UCL-2873	N/A	N/A
Switch Extension	R&S	OSP-B157WX	UCL-2867	1/03/2022	1/03/2023
Switch Extension	R&S	OSP-150W	UCL-2870	1/03/2022	1/03/2023

Table 2: List of equipment used for Direct Connect at the Antenna Port

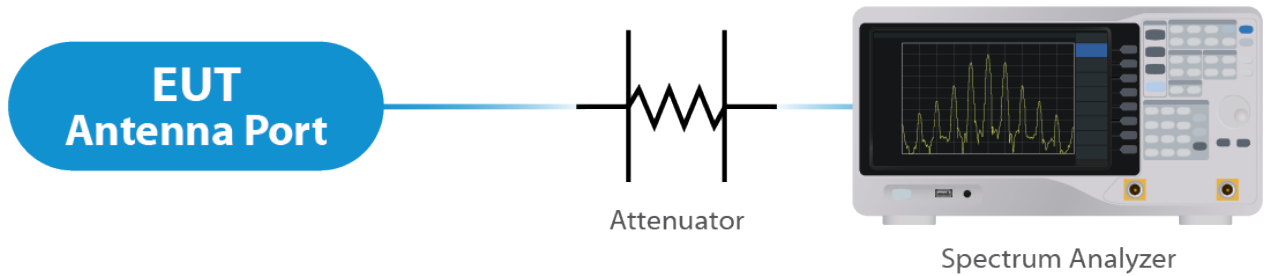


Figure 2: Direct Connect at the Antenna Port Test



Figure 3: Output Power Measurement

4.3 Radiated Emissions

Type of Equipment	Manufacturer	Model Number	Asset Number	Date of Last Calibration	Due Date of Calibration
EMI Receiver	Keysight	N9038A	UCL-2778	6/21/2021	6/21/2022
Pre-Amplifier 9 kHz – 1 GHz	Sonoma Instruments	310N	UCL-2889	10/7/2021	10/7/2022
Broadband Antenna	Scwarzbeck	VULB 9163	UCL-3062	8/28/2020	8/27/2022
Broadband Antenna	Scwarzbeck	VULB 9163	UCL-3071	5/19/2020	5/19/2022
Double Ridge Horn Antenna	Scwarzbeck	BBHA 9120D	UCL-3065	7/8/2021	7/8/2022
Log Periodic	Scwarzbeck	STLP 9129	UCL-3068	11/16/2020	11/16/2022
15 - 40 GHz Horn Antenna	Scwarzbeck	BBHA 9170	UCL-2487	5/21/2020	5/21/2022
1 – 18 GHz Amplifier	Com-Power	PAM 118A	UCL-3833	10/7/2021	10/7/2022
Test Software	UCL	Revision 1	UCL-3108	N/A	N/A

Table 3: List of equipment used for Radiated Emissions

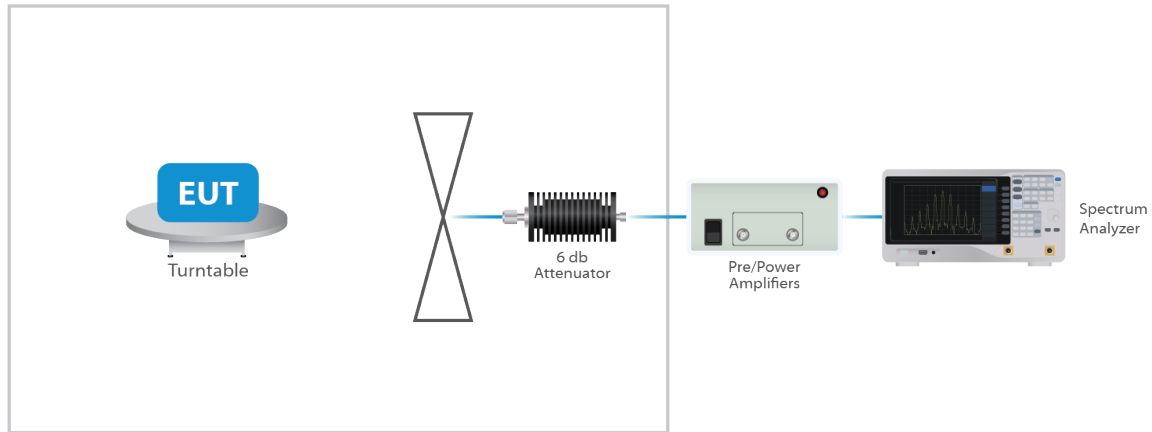


Figure 4: Radiated Emissions Test

4.4 Equipment Calibration

All applicable equipment is calibrated using either an independent calibration laboratory or Unified Compliance Laboratory personnel at intervals defined in ANSI C63.4:2014 following outlined calibration procedures. All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Supporting documentation relative to traceability is on file and is available for examination upon request.

4.5 Measurement Uncertainty

Test	Uncertainty (\pm dB)	Confidence (%)
Conducted Emissions	1.44	95
Radiated Emissions (9 kHz to 30 MHz)	2.50	95
Radiated Emissions (30 MHz to 1 GHz)	4.38	95
Radiated Emissions (1 GHz to 18 GHz)	4.37	95
Radiated Emissions (18 GHz to 40 GHz)	3.93	95
Direct Connect Tests	K Factor	Value
Emissions Bandwidth	2	2.0%
Output Power	2	1.0 dB
Peak Power Spectral Density	2	1.3 dB
Band Edge	2	0.8 dB
Transmitter Spurious Emissions	2	1.8 dB

5 Test Results

5.1 §15.203 Antenna Requirements

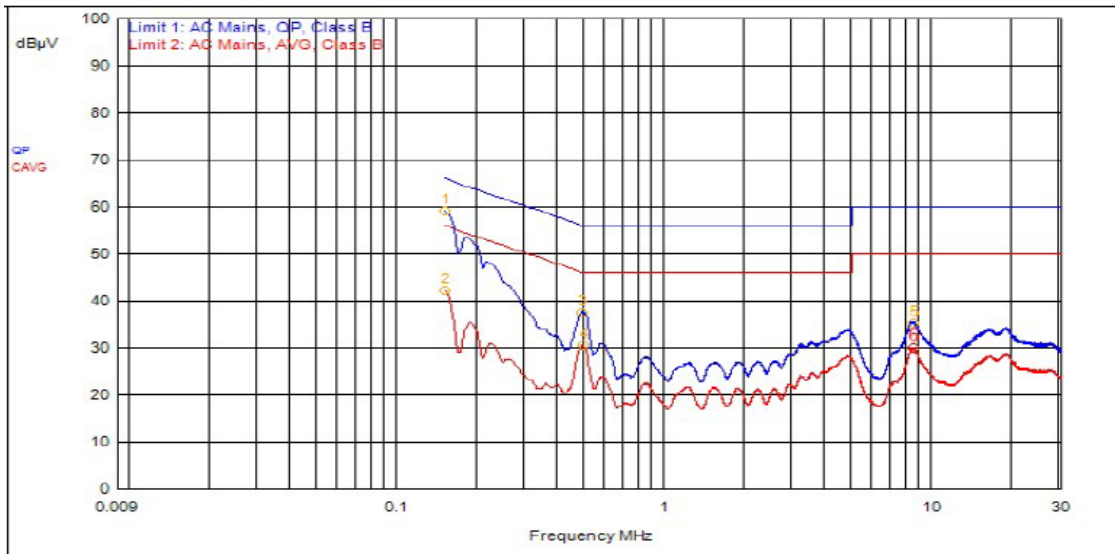
The EUT uses an integral antenna and an optional accessory dish antenna. The maximum gain of the integral antenna is 3 dBi and the optional dish antenna is 23 dBi. This is an 802.11 device and utilizes CDD as described in KDB 662911 D01. The integral antenna is not user replaceable. While the optional dish antenna is user replaceable. The EUT has a 2x2 transmitter and the chains are cross polarized.

Results

The EUT complied with the specification

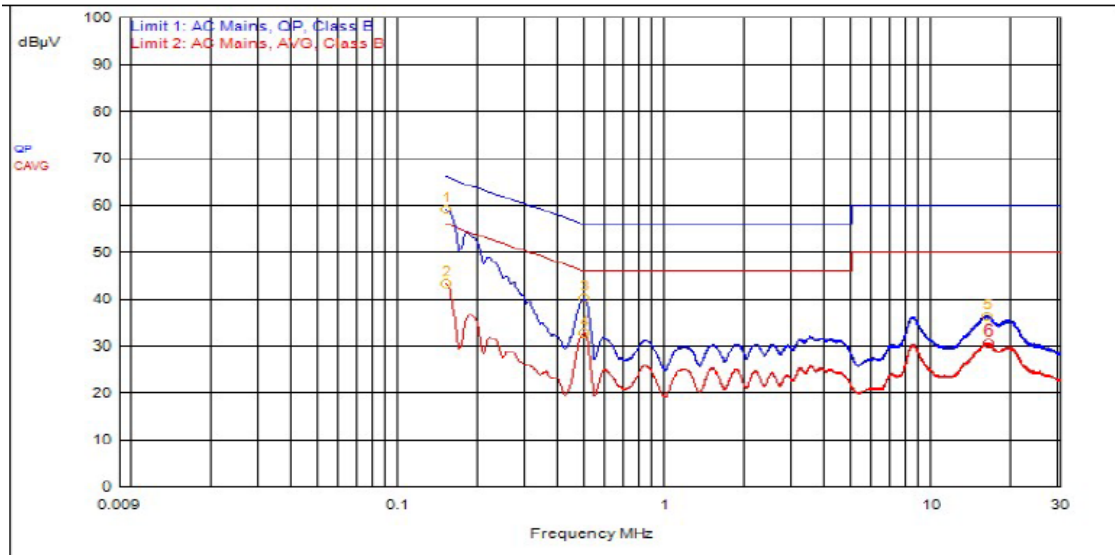
5.2 Conducted Emissions at Mains Ports Data

5.2.1 Line



ID	Frequency	Probe	Cable	Atten.	Detector	Meter Read	Meas Level	Limit 1	Limit 1 Dist.	Limit 2	Limit 2 Dist.
1	150,000kHz	12.4	0.0		QPeak	46.7	59.1	66.0	-6.9		
3	483,000kHz	12.4	0.0		QPeak	25.2	37.6	56.3	-18.7		
5	8.373MHz	12.3	0.2		QPeak	22.8	35.3	60.0	-24.7		
2	150,000kHz	12.4	0.0		C_AVG	29.7	42.1			56.0	-13.9
4	492,000kHz	12.4	0.0		C_AVG	18.1	30.5			46.1	-15.6
6	8.436MHz	12.3	0.2		C_AVG	17.4	29.9			50.0	-20.1

5.2.2 Neutral



ID	Frequency	Probe	Cable	Atten.	Detector	Meter Read	Meas Level	Limit 1	Limit 1 Dist.	Limit 2	Limit 2 Dist.
1	150,000kHz	12.4	0.0		QPeak	46.8	59.2	66.0	-6.8		
3	489,000kHz	12.4	0.0		QPeak	27.7	40.2	56.2	-16.0		
5	15.858MHz	12.4	0.2		QPeak	23.7	36.4	60.0	-23.6		
2	150,000kHz	12.4	0.0		C_AVG	30.8	43.2			56.0	-12.8
4	492,000kHz	12.4	0.0		C_AVG	20.5	32.9			46.1	-13.2
6	16.020MHz	12.4	0.2		C_AVG	18.0	30.6			50.0	-19.4

Result

The EUT complied with the specification limit.

5.3 §15.403(i) 26 dB Emissions Bandwidth

All chains were measured under the guidance of KDB 789033 Section II.C. and KDB 66291 D01. Please see associated annex for details on instrument settings.

Nominal BW (MHz)	Frequency (MHz)	99% Bandwidth (MHz)	26 dB Bandwidth (MHz)
20	5740	19.40	32.60
20	5790	37.40	53.50
20	5835	19.00	23.30
40	5750	38.25	57.40
40	5790	38.25	59.70
40	5825	37.75	40.20
80	5770	76.50	82.50
80	5790	77.00	82.50
80	5805	76.50	82.50

Result

All chains were tested and the highest bandwidth per chain is reported above.

The 26 dB bandwidths are reported for information purposes. Please see Annex for all bandwidth measurements.

5.4 §15.407(a)(3) Maximum Average Output Power

All chains were measured and summed under the guidance of KDB 789033 Section II. E.2. and KDB 66291 D01. Please see associated annex for details on instrument settings.

The maximum average RF conducted output power measured for this device was 26.9 dBm or 489.78 mW. The limit is 30 dBm, or 1 Watt when using an antenna with 23 dBi (Fixed point to point) or less gain. The integral antenna has a gain of 3 dBi with the dish antenna having a gain of 23 dBi. TP setting reflected are with the 23 dBi antenna.

Modulation (BW)	Frequency (MHz)	Data Rate	TP Setting	Conducted Output Power	Measured EIRP	Measured PSD
HE 20	5740	Mcs0	47	24.64	47.64	8.36
HE 20	5790	Mcs0	48	26.81	49.81	10.13
HE 20	5835	Mcs0	45	23.48	46.48	6.88
HE 40	5750	Mcs0	47	24.05	47.05	5.14
HE 40	5790	Mcs0	46	24.20	47.20	5.21
HE 40	5825	Mcs0	45	23.35	46.35	4.14
HE 80	5770	Mcs0	42	21.64	44.64	0.30
HE 80	5790	Mcs0	42	21.93	44.93	0.62
HE 80	5805	Mcs0	41	21.35	44.35	0.00

Result

In the configuration tested, the maximum summed average RF output power was less than 1 watt; therefore, the EUT complied with the requirements of the specification (see spectrum analyzer plots in attached Annex).

* Gated EIRP shown in the Annex is the conducted measurement

5.5 §15.407(b)(7) Spurious Emissions

5.5.1 Conducted Spurious Emissions

The frequency ranges from the lowest frequency generated or used in the device to the tenth harmonic of the highest fundamental frequency was investigated to measure any antenna-conducted emissions. The graphs show the measurement data from spurious emissions noted across the frequency range when transmitting at the lowest frequency, middle frequency and upper frequency. Shown within the annex are plots with the EUT turned to the upper and lower channels with the antenna gain of 23 dBi accounted for. These demonstrate compliance with the provisions of this section at the band edges.

All emissions shall be limited to a level of -27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

Result

Conducted spurious emissions were attenuated below the limit; therefore, the EUT complies with the specification.

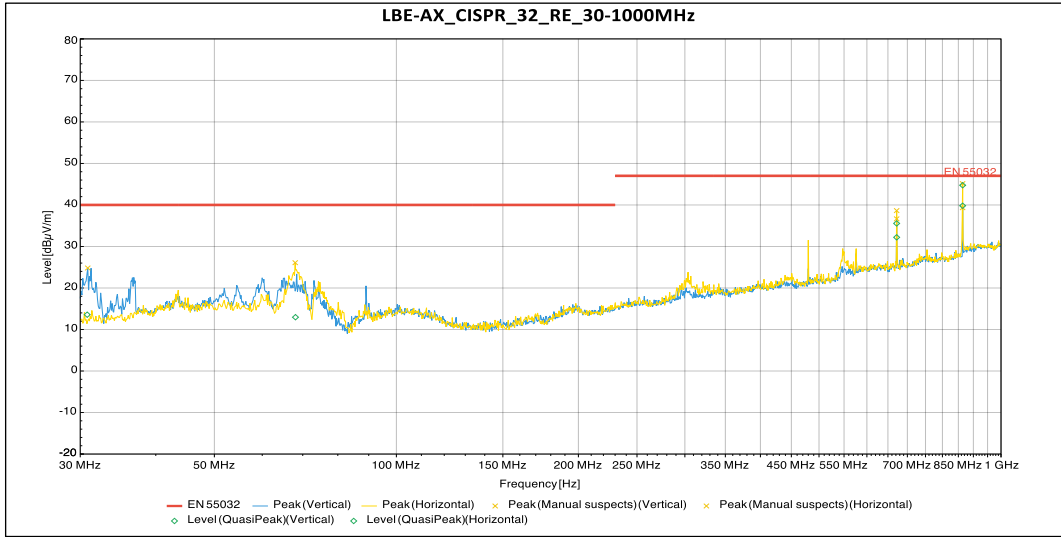
5.5.2 Radiated Spurious Emissions in the Restricted Bands of § 15.205

The EUT uses various power settings based on the channel in use. In order to reduce test time, the radiated spurious emissions at the lowest, middle, and highest channel were measured at the maximum power of TP60.

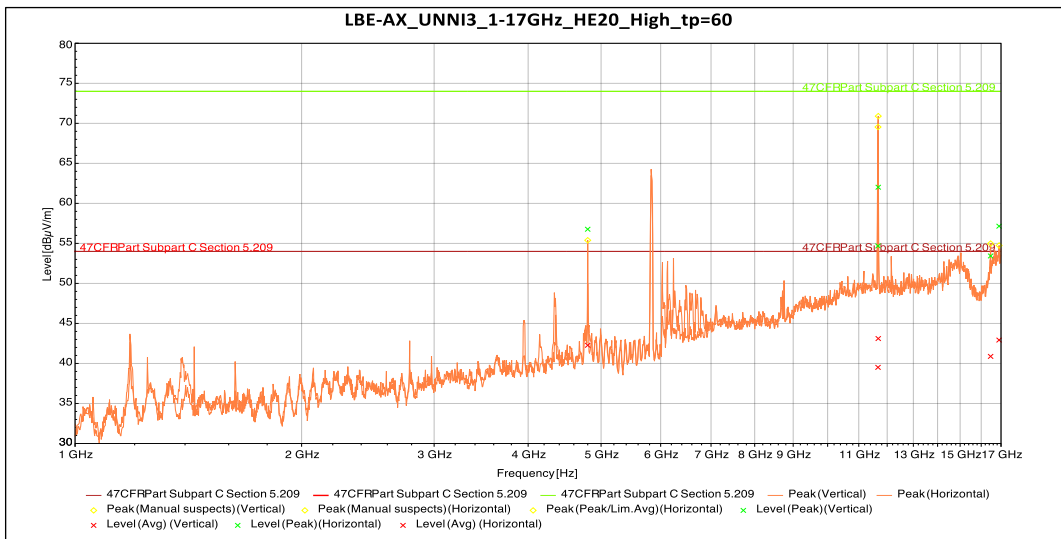
Correction Factor = Antenna Factor + Cable Loss - Pre-Amplifier Gain, and is added to the Receiver reading.

Result

All emissions in the restricted bands of § 15.205 met the limits specified in § 15.209; therefore, the EUT complies with the specification. See Annex for Conducted Band edge plots.

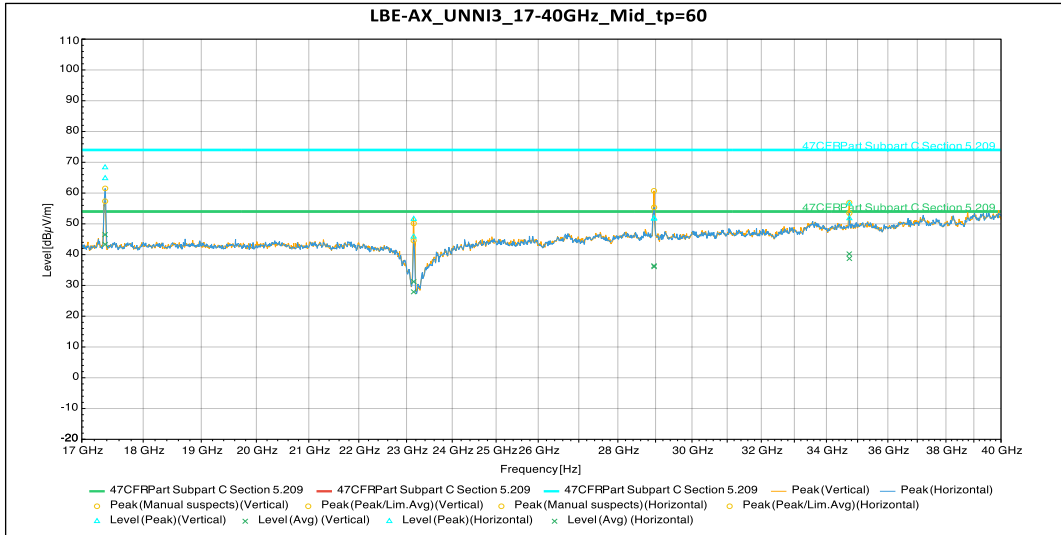


Source	Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin	Azimuth (°)	Height	Pol.	Correction (dB)
QuasiPeak	30.806 MHz	13.565	40	-26.435	224	2.59	Vertical	-15.5
QuasiPeak	672 MHz	32.198	47	-14.802	177	2.234	Vertical	-4.703
QuasiPeak	863.99 MHz	39.808	47	-7.192	334	2.628	Vertical	-1.466
QuasiPeak	68.093 MHz	12.963	40	-27.037	148	2.923	Horizontal	-15.671
QuasiPeak	671.94 MHz	35.553	47	-11.447	16	3.804	Horizontal	-4.704
QuasiPeak	863.99 MHz	44.752	47	-2.248	358	1.246	Horizontal	-1.466

Table 4: Radiated Emissions 30-1000MHz


Frequency	SR #	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Correction (dB)
4.7998 GHz	Peak	56.774	74	-17.226	180	3.15	Vertical	-8.325
11.668 GHz	Peak	54.68	74	-19.32	169	1.84	Vertical	5.727
16.467 GHz	Peak	53.43	74	-20.57	135	2.138	Vertical	9.936
4.7998 GHz	AVG	42.268	54	-11.732	180	3.15	Vertical	-8.325
11.668 GHz	AVG	39.512	54	-14.488	169	1.84	Vertical	5.727
16.467 GHz	AVG	40.876	54	-13.124	135	2.138	Vertical	9.936

Frequency	SR #	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Correction (dB)
11.676 GHz	Peak	62.024	74	-11.976	169	2.332	Horizontal	5.711
16.9 GHz	Peak	57.151	74	-16.849	165	1.637	Horizontal	11.801
11.676 GHz	AVG	43.114	54	-10.886	169	2.332	Horizontal	5.711
16.9 GHz	AVG	42.92	54	-11.08	165	1.637	Horizontal	11.801

Table 5: Radiated Emissions within 1-17GHz Transmitting on 5835 MHz


Frequency	SR #	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Pol.	Correction (dB)
17.373 GHz	Peak	68.319	74	-5.681	177	Vertical	-5.83
23.155 GHz	Peak	51.578	74	-22.422	180	Vertical	-5.485
28.958 GHz	Peak	51.618	74	-22.382	180	Vertical	-4.745
34.73 GHz	Peak	56.556	74	-17.444	148	Vertical	0.454
17.373 GHz	AVG	46.501	54	-7.499	177	Vertical	-5.83
23.155 GHz	AVG	31.233	54	-22.767	180	Vertical	-5.485
28.958 GHz	AVG	36.383	54	-17.617	180	Vertical	-4.745
34.73 GHz	AVG	40.242	54	-13.758	148	Vertical	0.454
17.374 GHz	Peak	64.786	74	-9.214	162	Horizontal	-5.827
23.153 GHz	Peak	45.83	74	-28.17	165	Horizontal	-5.373
28.962 GHz	Peak	51.836	74	-22.164	166	Horizontal	-4.72
34.734 GHz	Peak	51.784	74	-22.216	166	Horizontal	0.475
17.374 GHz	AVG	43.317	54	-10.683	162	Horizontal	-5.827
23.153 GHz	AVG	27.91	54	-26.09	165	Horizontal	-5.373
28.962 GHz	AVG	36.088	54	-17.912	166	Horizontal	-4.72
34.734 GHz	AVG	38.737	54	-15.263	166	Horizontal	0.475

Table 6: Radiated Emissions within 17-40GHz Transmitting on 5790 MHz

5.6 §15.407(a) Maximum Power Spectral Density

All chains were measured and summed under the guidance of KDB 789033 Section II. F. and KDB 66291 D01. Please see associated annex for details on instrument settings.

The maximum average power spectral density conducted from the intentional radiator of the antenna shall not be greater than 17 dBm in any 1 MHz band during any time interval of continuous transmission.

The EUT has a 2x2 transmitter and the chains are cross polarized.

Modulation (BW)	Frequency (MHz)	Data Rate	TP Setting	Measured PSD
HE 20	5740	Mcs0	47	8.36
HE 20	5790	Mcs0	48	10.13
HE 20	5835	Mcs0	45	6.88
HE 40	5750	Mcs0	47	5.14
HE 40	5790	Mcs0	46	5.21
HE 40	5825	Mcs0	45	4.14
HE 80	5770	Mcs0	42	0.30
HE 80	5790	Mcs0	42	0.62
HE 80	5805	Mcs0	41	0.00

Result

The maximum summed average power spectral density was less than the limit of 30 dBm; therefore, the EUT complies with the specification.

-- End of Test Report --