Amber Helm Development L.C.
92723 Michigan Hwy-152
Sister Lakes, Michigan 49047 USA
Tel: 888-847-8027

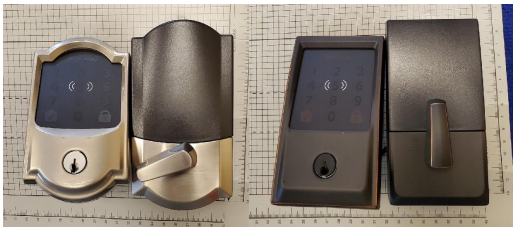
JACK1-WR2117B
Issued: **July 1, 2021**

NFC Test Report

regarding

USA: CFR Title 47, Part 15.209 (Emissions)
Canada: IC RSS-210v10 (Emissions)

for



BE499WB

Category: Electronic Door Lock

Judgments:
FCC Part 15.209 and ISED RSS-210v10
Testing Completed: July 13, 2021

TESTING
NVLAP LAB CODE 200129-0

Prepared for:

Allegion

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Date of Issue: July 1, 2021

Revision History

Rev. No.	Date	Details	Revised By
r0	July 1, 2021	Initial Release.	J. Brunett
r1	July 12, 2021	Correct plots and data.	J. Brunett
r2	July 19, 2021	Add ISED H-field limits.	J. Brunett
r3	July 23, 2021	Units and SDoC addressed.	J. Brunett

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1 Test Report Scope and Limitations

1.1 Laboratory Authorization

Test Facility description and attenuation characteristics are on file with the FCC Laboratory, Columbia, Maryland (FCC Reg. No: US5348 and US5356) and with ISED Canada, Ottawa, ON (File Ref. No: 3161A and 24249). Amber Helm Development L.C. holds accreditation under NVLAP Lab Code 200129-0.

1.2 Report Retention

For equipment verified to comply with the regulations herein, the manufacturer is obliged to retain this report with the product records for the life of the product, and no less than ten years. A copy of this Report will remain on file with this laboratory until August 2031.

1.3 Subcontracted Testing

This report does not contain data produced under subcontract.

1.4 Test Data

This test report contains data included within the laboratories scope of accreditation.

1.5 Limitation of Results

The test results contained in this report relate only to the item(s) tested. Any electrical or mechanical modification made to the test item subsequent to the test date shall invalidate the data presented in this report. Any electrical or mechanical modification made to the test item subsequent to this test date shall require reevaluation.

1.6 Copyright

1.7 Endorsements

This report shall not be used to claim product endorsement by any accrediting, regulatory, or governmental agency.

1.8 Test Location

The EUT was fully tested by **Amber Helm Development L.C.**, headquartered at 92723 Michigan Hwy-152, Sister Lakes, Michigan 49047 USA. Table 1 lists all sites employed herein. Specific test sites utilized are also listed in the test results sections of this report where needed.

Table 1: Test Site List.

Description	Location	Quality Num.
OATS (3 meter)	3615 E Grand River Rd., Williamston, Michigan 48895	OATSC

1.9 Traceability and Equipment Used

Pertinent test equipment used for measurements at this facility is listed in Table 2. The quality system employed at Amber Helm Development L.C. has been established to ensure all equipment has a clearly identifiable classification, calibration expiry date, and that all calibrations are traceable to the SI through NIST, other recognized national laboratories, accepted fundamental or natural physical constants, ratio type of calibration, or by comparison to consensus standards.

Table 2: Equipment List.

Description	Manufacturer/Model	SN	Quality Num.	Cal/Ver By / Date Due
Spectrum Analyzer	R & S / FSV30	101660	RSFSV30001	RS / Apr-2023
Spectrum Analyzer	R & S / FSW26	101873	RSFSW2601	RS / Sept-2021
Shielded Loop Antenna	EMCO / 6502	9502-2926	EMCOLOOP1	Keysight / Aug-2022
Biconical	EMCO / 93110B	9802-3039	BICEMCO01	Keysight / Aug-2021
Log Periodic Antenna	EMCO / 3146	9305-3614	LOGEMCO01	Keysight / Aug-2021

2 Test Specifications and Procedures

2.1 Test Specification and General Procedures

The goal of Allegion is to demonstrate that the Equipment Under Test (EUT) complies with the Rules and/or Directives below. Detailed in this report are the results of testing the Allegion BE499WB for compliance to:

Country/Region	Rules or Directive	Referenced Section(s)
United States	Code of Federal Regulations	CFR Title 47, Part 15.209
Canada	ISED Canada	IC RSS-210v10

It has been determined that the equipment under test is subject to the rules and directives above at the date of this testing. In conjunction with these rules and directives, the following specifications and procedures are followed herein to demonstrate compliance (in whole or in part) with these regulations.

ANSI C63.4:2014	"Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz"
ANSI C63.10:2013	"American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices"
IEEE Trans. EMC, Vol. 47, No. 3 August 2005	"Extrapolating Near-Field Emissions of Low-Frequency Loop Transmitters," J.D.Brunett, V.V.Liepa, D.L.Sengupta
TP0102RA	"AHD Internal Document TP0102 - Radiated Emissions Test Procedure"
ISED Canada	"The Measurement of Occupied Bandwidth"
ICES-003; Issue 7 (2020)	"Information Technology Equipment (ITE) - Limits and methods of measurement"

3 Configuration and Identification of the Equipment Under Test

3.1 Description and Declarations

The EUT is NFC enabled electronic door lock. The EUT is approximately 15 x 8 x 5 cm in dimension, and is depicted in Figure 1. It is powered by 6 VDC alkaline AA batteries. This product is used as an electronic entry door latch with NFC, WLAN, and BLE/Zigbee interfaces. Table 3 outlines provider declared EUT specifications.

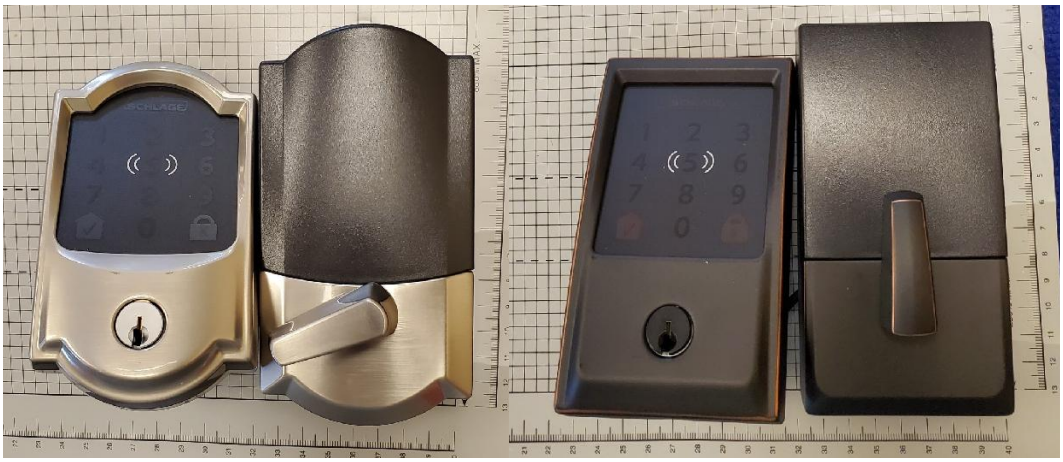


Figure 1: Photos of EUT.

Table 3: EUT Declarations.

General Declarations	
Equipment Type:	Electronic Door Lock
Country of Origin:	Not Declared
Nominal Supply:	6 VDC
Oper. Temp Range:	Not Declared
Frequency Range:	13.56 MHz
Antenna Dimension:	Integral
Antenna Type:	Coil
Antenna Gain:	Integral
Number of Channels:	1
Channel Spacing:	None
Alignment Range:	Not Declared
Type of Modulation:	ASK
United States	
FCC ID Number:	XPB-JACKALOPE
Classification:	DCD
Canada	
IC Number:	8053B-JACKALOPE
Classification:	LPT General Limits (9kHz - 30 MHz)

3.1.1 EUT Configuration

The EUT is configured for testing as depicted in Figure 2.

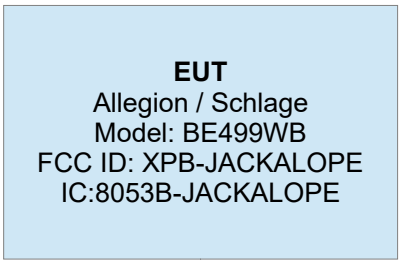


Figure 2: EUT Test Configuration Diagram.

3.1.2 Modes of Operation

The EUT is capable of operating as an NFC transceiver with integrated passive NFC tag. The passive tag is included during all measurements. In normal use the NFC transceiver POLLS with short pulses, and then performs a tag READ if a tag is detected.

3.1.3 Variants

There is only a single version of the EUT, as tested. The EUT can employ two different interchangeable escutcheon faceplates, both of which were tested herein.

3.1.4 Test Samples

Two samples of the EUT were provided for NFC emissions testing, and were tested in normal operating mode.

3.1.5 Functional Exerciser

Normal functionality was confirmed by measurement of transmitted signals.

3.1.6 Modifications Made

There were no modifications made to the EUT by this laboratory.

3.1.7 Production Intent

The EUT appears to be a production ready sample.

3.1.8 Declared Exemptions and Additional Product Notes

The EUT also employs an WLAN transceiver (which is addressed in detail in a separate test report) and a modularly certified BLE+Zigbee radio module integrated into the product, FCC ID: QOQMGM12P3 IC: 5123A-MGM12P3. Inter-modulation concerns relating to the other radios when operating simultaneously with this radio are addressed in the WLAN test report. Digital components of the EUT are covered by the suppliers SDoC.

4 Emissions

4.1 General Test Procedures

4.1.1 Radiated Test Setup and Procedures

Radiated electromagnetic emissions from the EUT are first pre-scanned in our screen room. Spectrum and modulation characteristics of all emissions are recorded. Instrumentation, including spectrum analyzers and other test equipment as detailed in Section 1.8 are employed. After pre-scan, emission measurements are made on the test site of record. If the EUT connects to auxiliary equipment and is table or floor standing, the configurations prescribed in relevant test standards are followed. Alternatively, a layout closest to normal use (as declared by the provider) is employed if the resulting emissions appear to be worst-case in such a configuration. See Figure 3. All intentionally radiating elements that are not fixed-mounted in use are placed on the test table lying flat, on their side, and on their end (3-axes) and the resulting worst case emissions are recorded. If the EUT is fixed-mounted in use, measurements are made with the device oriented in the manner consistent with installation and then emissions are recorded. If the EUT exhibits spurious emissions due to internal receiver circuitry, such emissions are measured with an appropriate carrier signal applied.

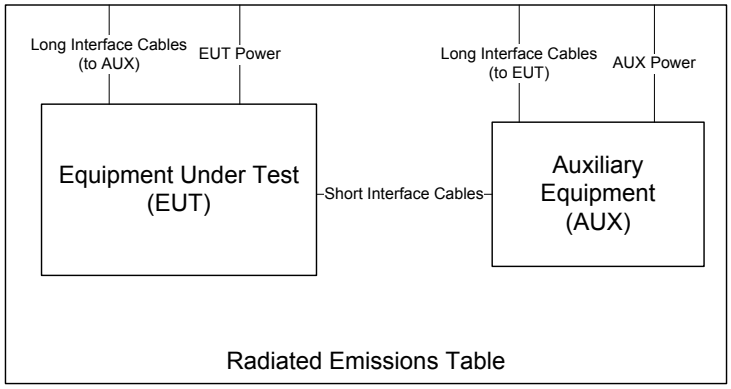


Figure 3: Radiated Emissions Diagram of the EUT.

For devices with intentional emissions below 30 MHz, a shielded loop antenna and/or E-field and H-Field broadband probes are used depending on the regulations. Shielded loops are placed at a 1 meter receive height at the desired measurement distance. For exposure in this band, the broadband probes employed are 10cm diameter single-axis shielded transducers and measurements are repeated and summed over three axes.

Emissions between 30 MHz and 1 GHz are measured using calibrated broadband antennas. For both horizontal and vertical polarizations, the test antenna is raised and lowered from 1 to 4 m in height until a maximum emission level is detected. The EUT is then rotated through 360^o in azimuth until the highest emission is detected. The test antenna is then raised and lowered one last time from 1 to 4 m and the worst case value is recorded. Emissions above 1 GHz are characterized using standard gain or broadband ridge-horn antennas on our OATS with a 4×5 m rectangle of ECCOSORB absorber covering the OATS ground screen and a 1.5m table height. Care is taken to ensure that test receiver resolution and video bandwidths meet the regulatory requirements, and that the emission bandwidth of the EUT is not reduced. Photographs of the test setup employed are depicted in Figure 4.

Where regulations allow for direct measurement of field strength, power values (dBm) measured on the test receiver / analyzer are converted to dBμV/m at the regulatory distance, using

$$E_{dist} = 107 + P_R + K_A - K_G + K_E - C_F$$

where P_R is the power recorded on spectrum analyzer, in dBm, K_A is the test antenna factor in dB/m, K_G is the combined pre-amplifier gain and cable loss in dB, K_E is duty correction factor (when applicable) in dB, and C_F is a distance conversion (employed only if limits are specified at alternate distance) in dB. This field strength value is then compared with the regulatory limit. If effective isotropic radiated power (EIRP) is computed, it is computed as

$$EIRP(dBm) = E_{3m}(dB\mu V/m) - 95.2.$$

When presenting data at each frequency, the highest measured emission under all possible EUT orientations (3-axes) is reported.

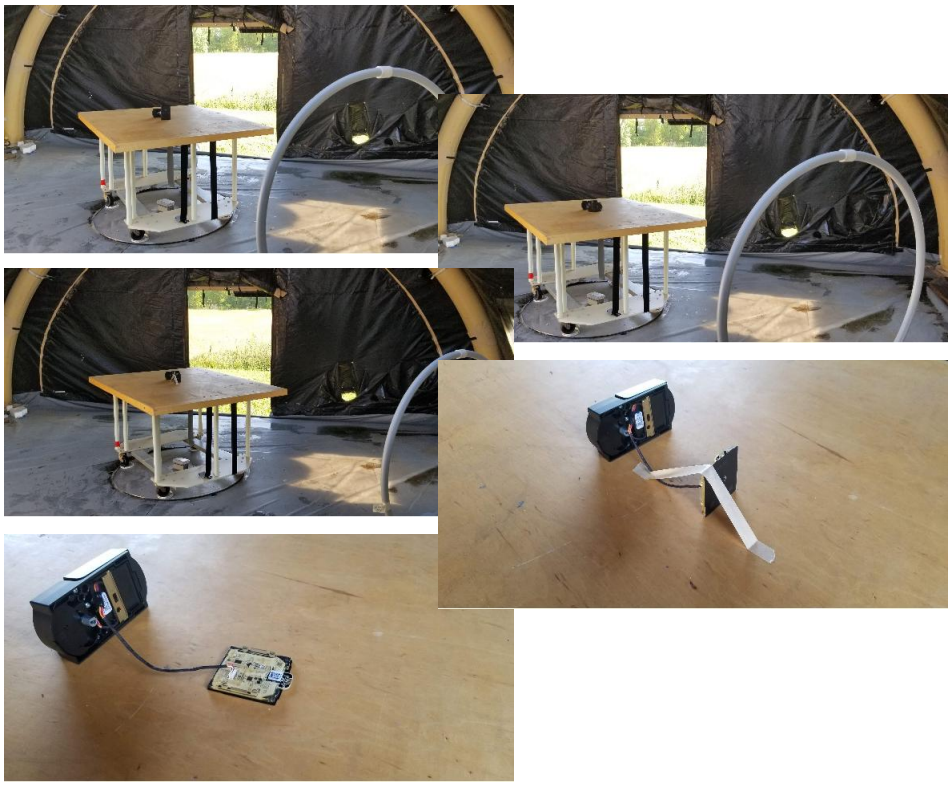


Figure 4: Radiated Emissions Test Setup Photograph(s).

4.1.2 Conducted Emissions Test Setup and Procedures

The EUT is not subject to measurement of power line conducted emissions as it is powered solely by its internal battery.

4.1.3 Power Supply Variation

Tests at extreme supply voltages are made if required by the procedures specified in the test standard, and results of this testing are detailed in this report.

In the case the EUT is designed for operation from a battery power source, the extreme test voltages are evaluated over the range specified in the test standard; no less than ±10% of the nominal battery voltage declared by the manufacturer. For all battery operated equipment, worst case intentional and spurious emissions are re-checked employing a new (fully charged) battery.

4.2 Intentional Emissions

4.2.1 Fundamental Emission Pulsed Operation

The details and results of testing the EUT for pulsed operation are summarized in Table 4.

Table 4: Pulsed Emission Characteristics (Duty Cycle).

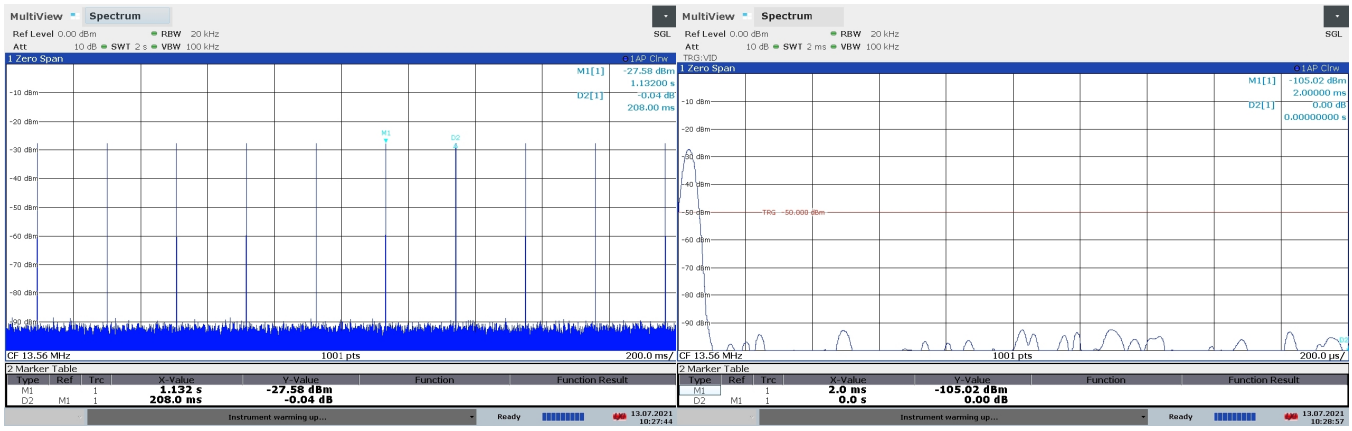
Frequency Range	Det	IF Bandwidth	Video Bandwidth
9 kHz ≤ f ≤ 150 kHz	Pk/QPk	200 Hz	300 Hz
150 kHz ≤ f ≤ 30 MHz	Pk/QPk	9 kHz/10 kHz	30 kHz
25 MHz ≤ f ≤ 1 000 MHz	Pk/QPk	120 kHz	300 kHz
f > 1 000 MHz	Pk	3 MHz	3MHz
f > 1 000 MHz	Avg	3 MHz	10kHz

Test Date:	13-Jul-21
Test Engineer:	Joseph Brunett
EUT Mode:	Normal Operating
Meas. Distance:	3 meters
EUT Tested:	Allegion BE499WB

		Overall Transmission			Internal Frame Characteristics			Computed Duty Cycle*	
#	EUT Mode	Min. Repetition Rate (sec)	Max. No. of Frames	Total Transmission Length (sec)	Max. Frame Length (ms)	Min. Frame Period (s)	Frame Encoding	(%)	Duty (dB)
R1	Polling	0.208	1	-	<0.1	>100 ms	In normal operation the EUT NFC device transmits a short pulse at 13.56 MHz every 208ms looking for a tag (coil loading change).	N/A	N/A
R2	Tag Read	Single	1	-	15	-	When a tag is detected the EUT NFC device will transmit a longer (15.2 ms) frame to read the tag. This frame occurs on every tag read.	N/A	N/A
#	C1	C2	C3	C4	C5	C6	C7	C8	C9

* No Duty Cycle is employed when demonstrating compliance.

POLLING



TAG READ

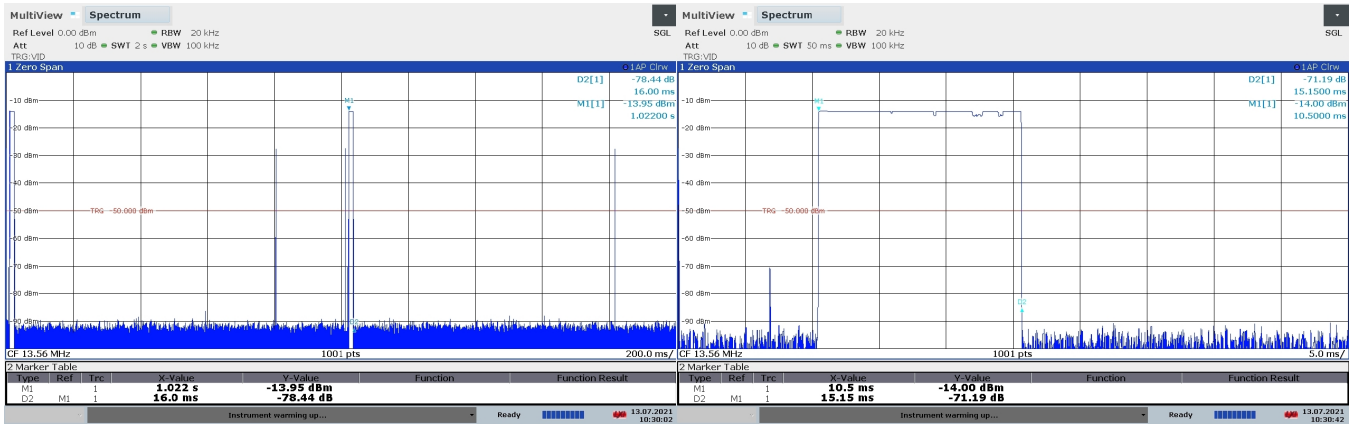


Figure 5: Pulsed Emission Characteristics (Duty Cycle).

4.2.2 Fundamental Emission Bandwidth

Emission bandwidth (EBW) of the EUT is measured with the device placed in the test mode(s) with the shortest available frame length and minimum frame spacing. Radiated emissions are recorded following the test procedures listed in Section 2.1. The 20 dB EBW is measured as the max-held peak-detected signal when the IF bandwidth is greater than or equal to 1% of the receiver span. For complex modulations other than ASK and FSK, the 99% emission bandwidth per IC test procedures has a different result, and is also separately reported.The results of EBW testing are summarized in Table 5. Plots showing measurements employed to obtain the emission bandwidth reported are provided in Figure 6.

Table 5: Intentional Emission Bandwidth.

Frequency Range	Det	IF Bandwidth	Video Bandwidth		
9 kHz ≤ f ≤ 150 kHz	Pk	> 1% Span	>= 3 * IFBW	**Test Date:**	28-Jun-21
150 kHz ≤ f ≤ 30 MHz	Pk	> 1% Span	>= 3 * IFBW	**Test Engineer:**	Joseph Brunett
				EUT Mode:	Normal Operating
				Meas. Distance:	0.1 meters
				EUT Tested:	Allegion BE499WB

#	Frequency Range (MHz)	Temp (C)	Supply (V)	99% PWR BW (kHz)	20 dB EBW (kHz)	fL (20 dBc) (MHz)	fL Limit (MHz)	fH (20 dBc) (MHz)	fH Limit (MHz)
R1	13.56	28	6	370.37	216.3	13.45161	13.410	13.66791	16.420
#	C1	C2	C3	C4	C5	C6	C7	C8	C9

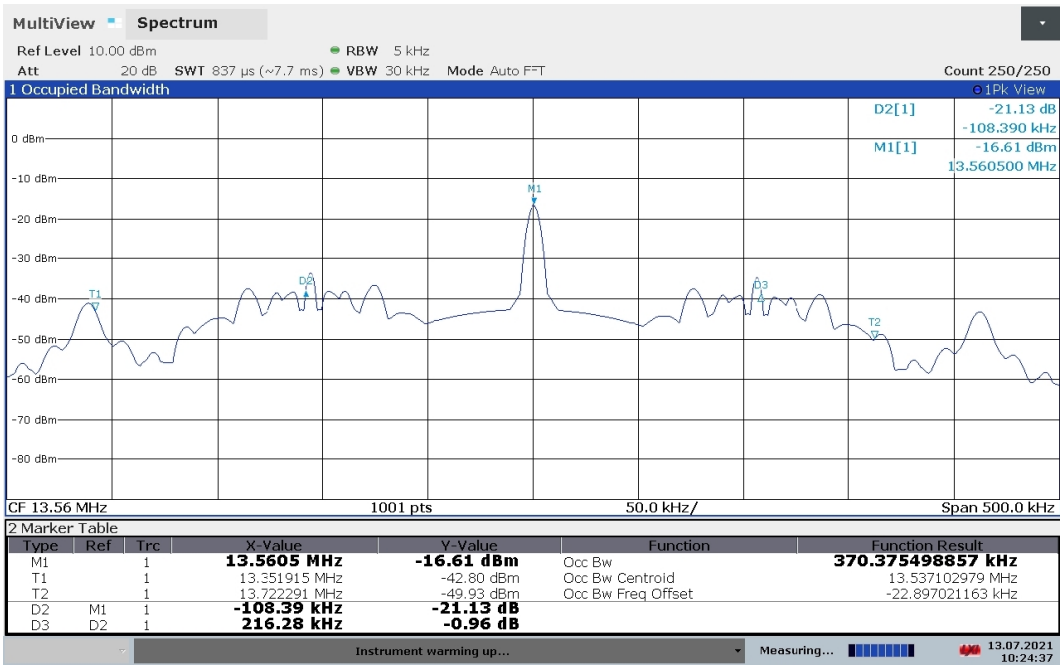


Figure 6: Intentional Emission Bandwidth.

4.2.3 Fundamental Emission

Following the test procedures listed in Section 2.1, field emissions measurements are made on the EUT for both Horizontal and Vertically polarized coupling fields. The EUT's loop antenna(s) are measured along all three axes, including when the EUT loop axes are aligned in the same axis as the test loop and aligned coplanar (in the same plane) with the test loop antenna. Table 6 details the results of these measurements.

Table 6: Fundamental Radiated Emissions.

Frequency Range	Det	IF Bandwidth	Video Bandwidth
9 kHz ≤ f ≤ 150 kHz	Pk/QPk	200 Hz	300 Hz
150 kHz ≤ f ≤ 30 MHz	Pk/QPk	9 kHz	30 kHz
30 MHz ≤ f ≤ 1 000 MHz	Pk/QPk	120 kHz	300 kHz

Test Date:	28-Jun-21
Test Engineer:	Joseph Brunett
Meas. Distance:	3 meters
EUT Tested:	Allegion BE499WB

Fundamental Emissions Measurements

#	Mode	Test Antenna Polarization	Freq. MHz	Ant. Used	Ant Ht.	Table Angle	Meas. Dist. m	Pr dBm	Ka dB/m	Kg dB	NF/FF boundary m	Cf** 3 m / 30 m dB	E3m (Pk) Pk dBuV/m	E30m Pk dBuV/m	E30m QPk/Avg dBuV/m	E30m Limit dBuV/m	H30m Pk dBuA/m	H30m Pk dBuA/m	H30m ISED Limit dBuA/m	Pass By***
R1	POLL – No Faceplate	Coaxial - Horz	13.56	EMCOLOOP1	1.0	330.0	3.0	-47.6	10.6	0.8	3.5	40.0	69.2	29.2		29.5	-22.3		-21.9	**0.3**
R2	POLL – No Faceplate	Coplanar – Horz	13.56	EMCOLOOP1	1.0	330.0	3.0	-54.0	10.6	0.8	3.5	40.0	62.8	22.8		29.5	-28.7		-21.9	6.7
R3	POLL – No Faceplate	Coplanar – Vert	13.56	EMCOLOOP1	1.0	330.0	1.0	-57.4	10.6	0.8	3.5	40.0	59.4	19.4		29.5	-32.1		-21.9	10.1
R4																				
R5	POLL – RD Faceplate	Coaxial - Horz	13.56	EMCOLOOP1	1.0	330.0	3.0	-58.2	10.6	0.8	3.5	40.0	58.6	18.6		29.5	-32.9		-21.9	10.9
R6	POLL – SQ Faceplate	Coaxial - Horz	13.56	EMCOLOOP1	1.0	330.0	3.0	-57.3	10.6	0.8	3.5	40.0	59.5	19.5		29.5	-32.0		-21.9	10.0
#	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16				C17

* EUT was tested in Pulsed mode. No averaging applied, Peak data reported to demonstrate compliance. Emissions reduce when metal face plates are attached over NFC PCB.
** 40 dB/dec near field conversion factor, 20 dB/dec far-field conversion factors are permitted. NF/FF Boundary at lambda/2pi distance for small radiator.

4.3 Unintentional Emissions

4.3.1 Transmit Chain Spurious Emissions

The results for the measurement of transmit chain spurious emissions at the nominal voltage and temperature are provided in Table 7. Following the test procedures listed in Section 2.1, field emissions measurements are made on the EUT for both Horizontal and Vertically polarized coupling fields. The EUT's loop antenna(s) are measured when the EUT loop axes placed in all three axes, including when they are aligned along the same axis as the test loop antenna and are aligned coplanar with the test loop antenna. For all arrangements, test loop is rotated for maximum field. The results for the measurement of transmit chain spurious emissions at the nominal voltage and temperature are provided in Table 7. Measurements are performed to 10 times the highest fundamental operating frequency.

Table 7: Transmit Chain Spurious Emissions.

Frequency Range	Det	IF Bandwidth	Video Bandwidth		
9 kHz ≤ f ≤ 150 kHz	Pk/QPk	200 Hz	300 Hz	**Test Date:**	28-Jun-21
150 kHz ≤ f ≤ 30 MHz	Pk/QPk	9 kHz	30 kHz	**Test Engineer:**	Joseph Brunett
25 MHz ≤ f ≤ 1 000 MHz	Pk/QPk	120 kHz	300 kHz	**Meas. Distance:**	3 meters
				EUT Tested:	Allegion BE499WB

Transmit Chain Spurious Emissions

#	Mode	Test Antenna Polarization	Freq. Start MHz	Freq. Stop MHz	Ant. Used	Ant Ht. m	Table Angle deg	Meas. Dist. m	Ka dB/m	Kg dB	NF/FF boundary m	Cf** (3 to 30m) dB	E-field*** (Pk) dBuV/m	E-field*** (Qpk/Avg) dBuV/m	E-field Limit (30m / 3m) dBuV/m	H-field*** (Pk) dBuA/m	H-field*** (Qpk/Avg) dBuA/m	ISED H-field Limit (30m / 3m) dBuA/m	Pass By	Comments
R1	POLL – No Faceplate	Coaxial - Horz	27.1	27.1	EMCOLOOP1	1.0	330.0	3.0	8.7	0.0	1.8	20.0	-7.3		29.5	-58.8		-21.9	36.9	max all, noise
R2		H/V (worst case)	40.7	40.7	BICEMCO01	1.0	max all	3.0	11.5	-.4		.0	21.0		40.0				19.0	noise
R3		H/V (worst case)	54.2	54.2	BICEMCO01	1.0	max all	3.0	10.1	-.4		.0	25.6		40.0				14.4	noise
R4		H/V (worst case)	67.8	67.8	BICEMCO01	1.0	max all	3.0	9.7	-.4		.0	33.0		40.0				**7.0**	background
R5		H/V (worst case)	81.4	81.4	BICEMCO01	1.0	max all	3.0	9.5	-.5		.0	22.9		40.0				17.1	noise
R6		H/V (worst case)	94.9	94.9	BICEMCO01	1.0	max all	3.0	9.7	-.5		.0	31.5		43.5				12.0	background
R7		H/V (worst case)	108.5	108.5	BICEMCO01	1.0	max all	3.0	10.6	-.6		.0	27.2		43.5				16.3	background
R8		H/V (worst case)	122.0	122.0	BICEMCO01	1.0	max all	3.0	11.7	-.6		.0	22.4		43.5				21.1	noise
R9		H/V (worst case)	135.6	135.6	BICEMCO01	1.0	max all	3.0	12.3	-.6		.0	24.0		43.5				19.5	noise
#	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20

* EUT was tested in CW mode. No averaging applies and Quasi-Peak data was not needed to demonstrate compliance.

** 40 dB/dec near field conversion factor, 20 dB/dec far-field conversion factors are permitted. NF/FF Boundary at lambda/2pi distance for small radiator.

*** When E-field is reported directly from Spectrum Analyzer, Antenna Factors and Cable losses are included directly in SA settings.

5 Measurement Uncertainty and Accreditation Documents

The maximum values of measurement uncertainty for the laboratory test equipment and facilities associated with each test are given in the table below. This uncertainty is computed for a 95.45% confidence level based on a coverage factor of $k = 2$.

Table 8: Measurement Uncertainty.

Measured Parameter	Measurement Uncertainty†
Radio Frequency	$\pm(f_{Mkr}/10^7 + RBW/10 + (SPN/(PTS-1))/2 + 1\,\text{Hz})$
Conducted Emm. Amplitude	$\pm 1.9\,\text{dB}$
Radiated Emm. Amplitude ($f < 30\,\text{MHz}$)	$\pm 3.1\,\text{dB}$
Radiated Emm. Amplitude ($30 - 200\,\text{MHz}$)	$\pm 4.0\,\text{dB}$
Radiated Emm. Amplitude ($200 - 1000\,\text{MHz}$)	$\pm 5.2\,\text{dB}$
Radiated Emm. Amplitude ($f > 1000\,\text{MHz}$)	$\pm 3.7\,\text{dB}$

†Ref: CISPR 16-4-2:2011+A1:2014


United States Department of Commerce
National Institute of Standards and Technology

NVLAP® ilac-MRA

Certificate of Accreditation to ISO/IEC 17025:2017

NVLAP LAB CODE: 200129-0

AHD (Amber Helm Development, L.C.)
Sister Lakes, MI

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

Electromagnetic Compatibility & Telecommunications

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).

2020-06-23 through 2021-06-30
Effective Dates

For the National Voluntary Laboratory Accreditation Program

Figure 7: Accreditation Documents