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

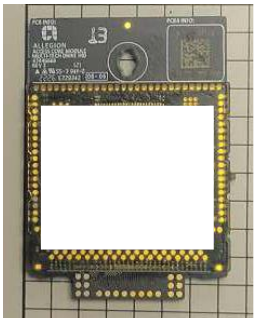
ALGACA-WR2241USA
Issued: **March 1, 2023**

NFC Test Report

regarding

USA: CFR Title 47, Part 15.225 (Emissions)
Canada: RSS-210v10/GENv5 (Emissions)

for



47446668, 47446670

Category: Keycard Access Module

Judgments:
Complies with FCC Part 15.225, and ISED RSS-210v10
Testing Completed: March 1, 2023

TESTING
NVLAP LAB CODE 200129-0

Prepared for:

Allegion, PLC

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Rpt. Prep./Rev. by: John Nantz

Date of Issue: March 1, 2023

Revision History

Rev. No.	Date	Details	Revised By
r0	March 1, 2023	Initial Release.	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 April 2033.

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 laboratory's scope of accreditation. Any data in this report that is not covered under the laboratory's scope is clearly identified.

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-2024
Spectrum Analyzer	R & S / FPC1500	101692	RSFPC15001	RS / Dec-2023
Shielded Loop Antenna	EMCO / 6507	9012-1264	EMCOLOOP2	Keysight / Aug-2023
Biconical	EMCO / 93110B	9802-3039	BICEMCO01	Keysight / Aug-2023
Log Periodic Antenna	EMCO / 3146	9305-3614	LOGEMCO01	Keysight / Aug-2023

2 Test Specifications and Procedures

2.1 Test Specification and General Procedures

The goal of Allegion, PLC 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, PLC 47446668, 47446670 for compliance to:

Country/Region	**Rules or Directive**	**Referenced Section(s)**
United States	Code of Federal Regulations	CFR Title 47, Part 15.225
Canada	ISED Canada	RSS-210v10/GENv5

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"
TP0102RA	"AHD Internal Document TP0102 - Radiated Emissions Test Procedure"

3 Configuration and Identification of the Equipment Under Test

3.1 Description and Declarations

The EUT is an access card reader module. The EUT is approximately 3.5 x 5 x 0.5 cm in dimension, and is depicted in Figure 1. It is powered by 3.3 VDC lock power system. This product is used as an access reader to enable key free access to the manufacturer's lockset host products. Table 3 outlines provider declared EUT specifications.

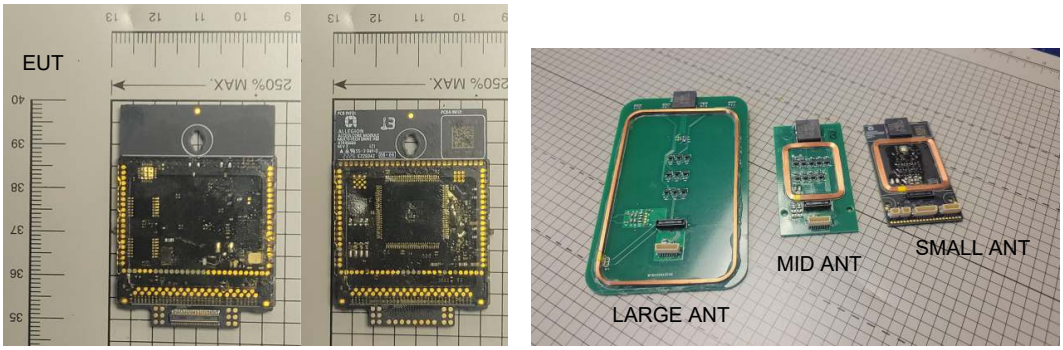


Figure 1: Photos of EUT.

Table 3: EUT Declarations.

General Declarations	
Equipment Type:	Keycard Access Module
Country of Origin:	Not Declared
Nominal Supply:	3.3 VDC
Oper. Temp Range:	Not Declared
Frequency Range:	13.56 MHz
Antenna Dimension:	Integral
Antenna Type:	Coils (large, medium, small)
Antenna Gain:	Integral
Number of Channels:	1
Channel Spacing:	None
Alignment Range:	Not Declared
Type of Modulation:	ASK
United States	
FCC ID Number:	XPB-47446668
Classification:	DXX
Canada	
IC Number:	8053B-47446668
Classification:	Other

3.1.1 EUT Configuration

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

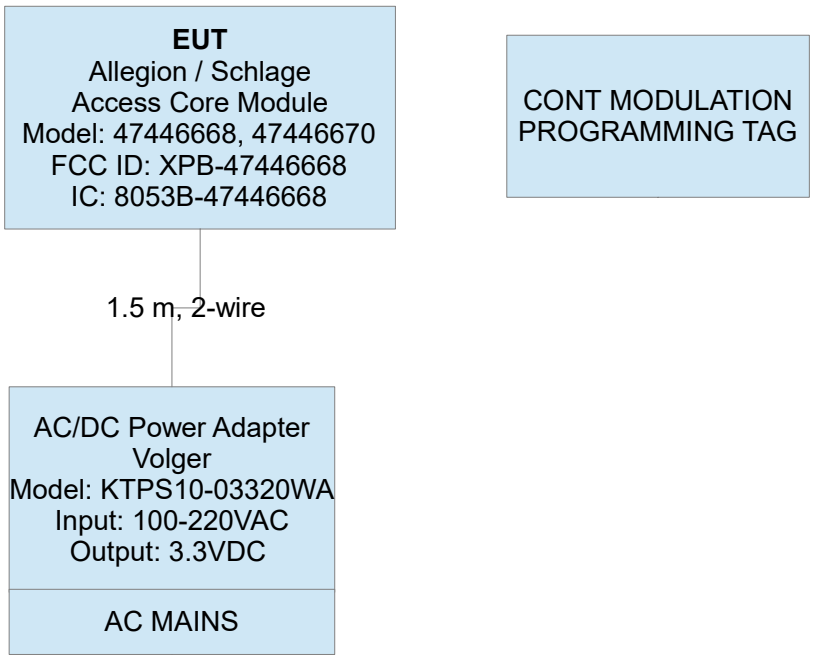


Figure 2: EUT Test Configuration Diagram.

3.1.2 Modes of Operation

The EUT is capable of two modes of operation, POLLING continuously to detect a 13.56 MHz tag and TAG READ interrogation if detected. Both modes are tested herein. Digital spurious and AC mains spurious emissions are reported with the radio active. Furthermore, this EUT has been evaluated when co-located with this manufacturer's DTS transceiver modules (Digital Core modules, FCC ID: XPB-47334321, IC: 8053B-47334321 and FCC ID: XPB-47334317, IC: 8053B-47334317) in a separate host / cabinet emissions report, AHD Report No. ALGACA-WR2240USC.

3.1.3 Variants

There are two variants of the EUT, 47446668 and 47446670 which includes an additional digital HID security IC. The most populated variant 47446670 was fully tested. This product is identical in design and construction to FCC ID: XPB-47446672, IC: 8053B-47446672, but has its 125 kHz reading circuitry depopulated and is thus seeking a separate authorization.

3.1.4 Test Samples

Two samples of the fully populated EUT were provided for testing along with 3 unique PCB antennas that can be employed. Each EUT sample was capable of either normal operation or forced transmission for testing via a UART / PC terminal interface. Test data is provided demonstrating compliance with all three antenna boards. The EUT employs unique power and antenna board connectors used only by the module manufacturer, preventing this module's use in any device other than those tested and authorized by this module manufacturer.

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 is a module, subject to further compliance evaluation in every host lockset into which it may be employed. The manufacturer intends to complete this testing via SDoC evaluation completed separately.

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.

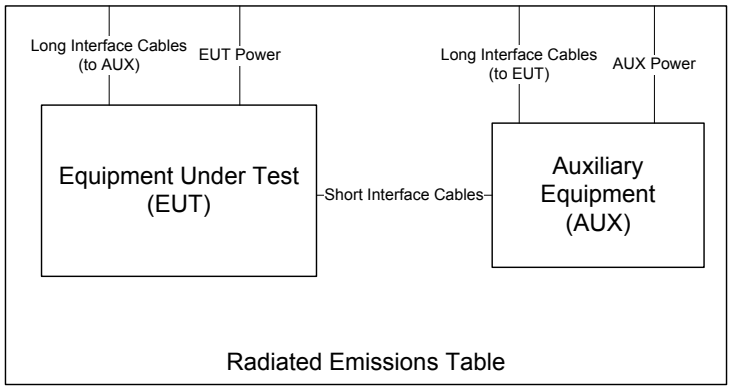


Figure 3: Radiated Emissions Diagram of the EUT.

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 regulation. Shielded loops are placed at a 1 meter receive height at the desired measurement distance. For exposure in this band, 10cm diameter single-axis broadband probes meeting the requirements of ISED SPR-002 section 5.2 are employed. Measurements are repeated and summed over three axes, and the entire frequency range is measured with and without the EUT transmitting.

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.

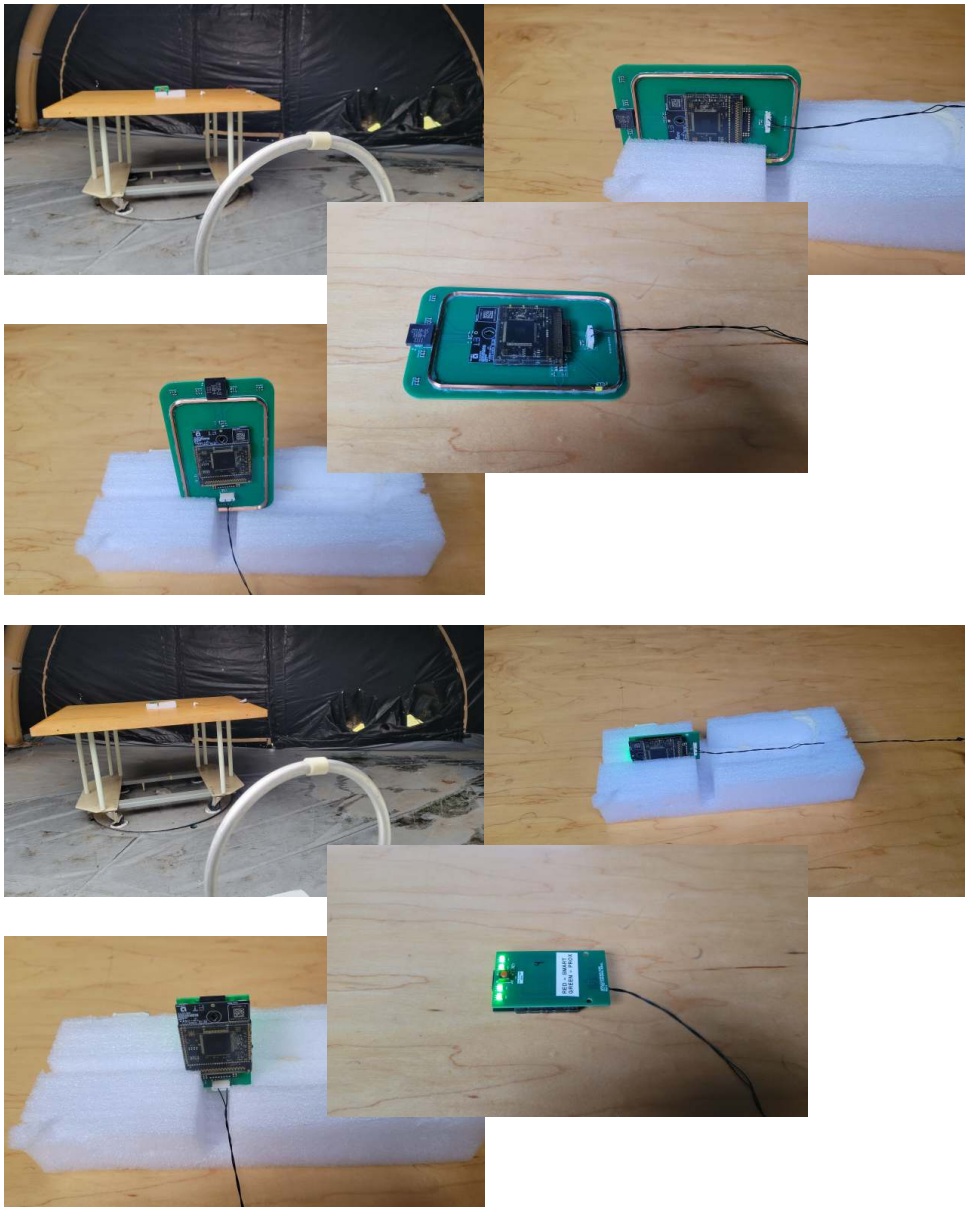


Figure 4: Radiated Emissions Test Setup Photograph(s).

4.1.2 Conducted Emissions Test Setup and Procedures

AC Port Conducted Spurious For this device, AC power line conducted emissions are measured in our screen room. If the EUT connects to auxiliary equipment and is table or floor standing, the configurations prescribed in ANSI C63.4 / CISPR 22 are employed. Alternatively, an on-table layout more representative of actual use may be employed if the resulting emissions appear to be worst-case in such a configuration. See Figure 5.

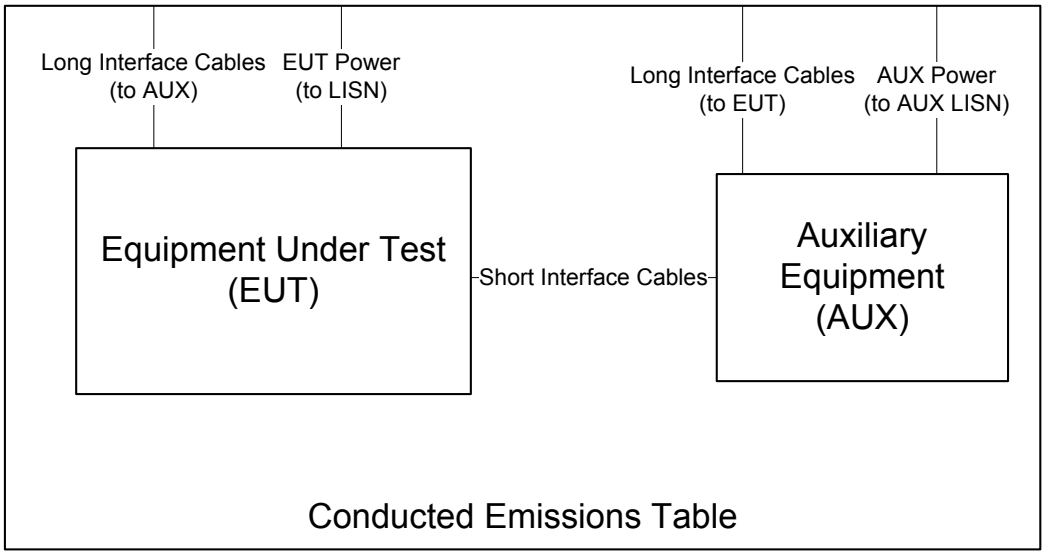


Figure 5: Conducted Emissions Setup Diagram of the EUT.

Conducted emissions are measured and recorded for each AC mains power source over the spectrum 0.15 MHz to 30 MHz for both the ungrounded (HI/PHASE) and grounded (LO/GND) conductors with the EUT placed in its highest current draw operating mode(s). The test receiver is set to peak-hold mode in order to record the peak emissions throughout the course of functional operation. Only if an emission exceeds or is near the limit are quasi-peak and average detection applied. Photographs of the test setup employed are depicted in Figure 6.

Figure 6: Conducted Emissions Test Setup Photograph(s).

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 of this EUT, measurements of the worst-case radiated emissions are performed with the supply voltage varied by no less than 85% and 115% of the nominal rated value for devices connecting to AC power mains.

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:	11-Dec-22
Test Engineer:	J. Brunett
EUT Mode:	Normal Operating
Meas. Distance:	3 meters
EUT Tested:	Allegion NFC

R0		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 (ms)	Frame Encoding	(%)	Duty (dB)
R1	13.56 MHz Polling	0.730	8	-	32.8	41.1	In normal operation the EUT NFC device transmits 8 short pulses at 13.56 MHz every 730ms looking for a tag (coil loading change).	N/A	N/A
R2	13.56 MHz Tag Read	Single	1	-	104.1	-	When a tag is detected the EUT NFC device will transmit a longer (104 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

(ROW) (COLUMN) NOTE:
R0 C8/C9 No Duty Cycle is employed when demonstrating compliance.

Figure 7: Example 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 8.

Table 5: Intentional Emission Bandwidth.

Frequency Range	**Det**	**IF Bandwidth**	**Video Bandwidth**	**Test Date:**	11-Dec-22
9 kHz ≤ f ≤ 150 kHz	Pk	> 1% Span	>= 3 * IFBW	**Test Engineer:**	J. Brunett
150 kHz ≤ f ≤ 30 MHz	Pk	> 1% Span	>= 3 * IFBW	**EUT Mode:**	See Below
				Meas. Distance:	0.1 meters
				EUT Tested:	Allegion NFC

R0	Mode	Frequency Range (MHz)	Temp (C)	Supply (V)	99% PWR BW (kHz)	20 dB EBW (kHz)	fL (20 dBc) (MHz)	fH (20 dBc) (MHz)
R1	13.56 MHz Polling	13.56	20	3.3	493.20	431.47	13.346	13.778
R2	13.56 MHz Tag Read	13.56	20	3.3	531.30	434.01	13.343	13.777
#	C1	C2	C3	C4	C5	C6	C7	C9

(ROW) (COLUMN) NOTE:

Figure 8: Example 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(a): 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:	11-Dec-22
Test Engineer:	J. Brunett
Meas. Distance:	3 meters
EUT Tested:	Allegion NFC
EUT Mode:	CM

Fundamental Emissions Measurements

R0	Mode / Antenna	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	E30m QPk/Avg	E30m Limit	H30m Pk	H30m QPk/Avg	H30m Limit	Pass By
														dBuV/m			dBuA/m			
R1	CM (Large Antenna)	Coaxial - Horz	13.56	EMCOLOOP1	1.0	90.0	3.0		16.9	0.8	3.5	20.0	73.3	53.3		84.0	1.8			**30.7**
R2		Coplanar – Horz	13.56	EMCOLOOP1	1.0	90.0	3.0		16.9	0.8	3.5	20.0	68.9	48.9		84.0	-2.6			35.1
R3		Coplanar – Vert	13.56	EMCOLOOP1	1.0	90.0	3.0		16.9	0.8	3.5	20.0	65.2	45.2		84.0	-6.3			38.8
R4	CM (Medium Antenna)	Coaxial - Horz	13.56	EMCOLOOP1	1.0	90.0	3.0		16.9	0.8	3.5	20.0	63.3	43.3		84.0	-8.2			40.7
R5	CM (Small Antenna)	Coaxial - Horz	13.56	EMCOLOOP1	1.0	90.0	3.0		16.9	0.8	3.5	20.0	58.3	38.3		84.0	-13.2			45.7

Frequency Stability over Temperature/Voltage

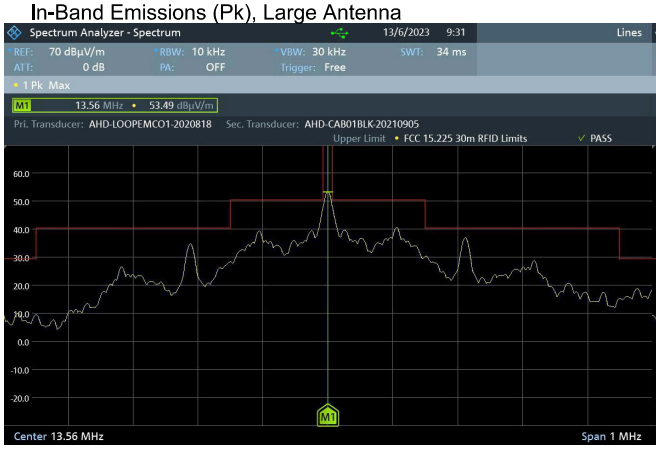
R6	Mode	Temp (°C)	Freq. (MHz)	Voltage (VDC)	Freq. Variation (+/- ppm)	Freq. Variation Limit (+/- ppm)	Pass
R7	CM	20	13.560168	3.3	BASELINE		
R8	CM	-20	13.560112	3.3	-4	100	TRUE
R9	CM	55	13.560558	3.3	29	100	TRUE
R10	CM	20	13.560068	3.5	-7	100	TRUE
R11	CM	20	13.560673	2.8	off	off	

#	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20

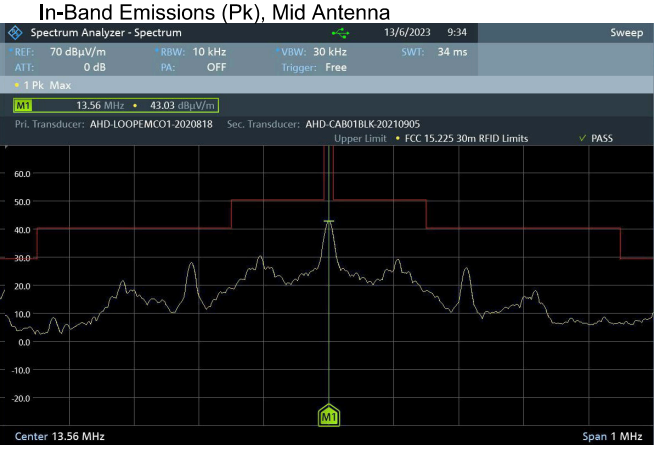
(ROW)	(COLUMN)	NOTE:
R0	C1	EUT was tested in CM mode. No averaging applied, Peak data reported to demonstrate compliance.
R0	C11	NF/FF Boundary at lambda/2pi distance for small radiator.
R0	C12	40 dB/dec near field conversion factor, 20 dB/dec far-field conversion factors are permitted. 20dB is chosen to show compliance under worst case conversion.
R0	C13	When E-field is reported directly from Spectrum Analyzer, Antenna Factors and Cable losses are included directly in SA settings.
R0	C17	H-field is computed by subtracting dBΩ in freespace from E-Field measurements = 20*log(120π) = 51.5dB

Table 6(b): Fundamental Radiated Emissions.

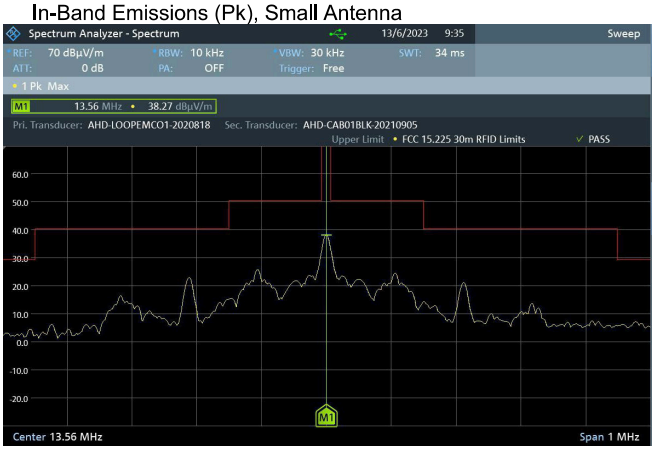
In-Band Emissions (Pk), Large Antenna



In-Band Emissions (Pk), Mid Antenna



In-Band Emissions (Pk), Small Antenna



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:**	21-Dec-22
150 kHz ≤ f ≤ 30 MHz	Pk/QPk	9 kHz	30 kHz	**Test Engineer:**	J. Brunett
25 MHz ≤ f ≤ 1 000 MHz	Pk/QPk	120 kHz	300 kHz	**Meas. Distance:**	3 meters
				EUT Tested:	Allegion NFC

Transmit Chain Spurious Emissions

#	Mode / Antenna	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	E3m (Pk) Pk dBuV/m	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	CM (Large Antenna)	Coaxial - Horz	27.1	27.1	EMCOLOOP1	1.0	90.0	3.0	8.7	1.0	1.8	20.0	40.0	20.0		49.5	-31.5		-21.9	9.6	Max all
R2		H/V (worst case)	40.7	40.7	BICEMCO01	1.0	max all	3.0	11.5	-.4			33.1	33.1		40.0				**6.9**	background
R3		H/V (worst case)	54.2	54.2	BICEMCO01	1.0	max all	3.0	10.1	-.4			23.8	23.8		40.0				16.2	background
R4		H/V (worst case)	67.8	67.8	BICEMCO01	1.0	max all	3.0	9.7	-.4			27.7	27.7		40.0				12.3	background
R5		H/V (worst case)	81.4	81.4	BICEMCO01	1.0	max all	3.0	9.5	-.5			18.1	18.1		40.0				21.9	background
R6		H/V (worst case)	94.9	94.9	BICEMCO01	1.0	max all	3.0	9.7	-.5			37.3	38.0		43.5				5.5	background
R7		H/V (worst case)	108.5	108.5	BICEMCO01	1.0	max all	3.0	10.6	-.6			24.7	24.7		43.5				18.8	background
R8		H/V (worst case)	122.0	122.0	BICEMCO01	1.0	max all	3.0	11.7	-.6			24.0	24.0		43.5				19.5	background
R9		H/V (worst case)	135.6	135.6	BICEMCO01	1.0	max all	3.0	12.3	-.6			21.9	21.9		43.5				21.6	background
R10	CM (Mid Antenna)	Coaxial - Horz	27.1	27.1	EMCOLOOP1	1.0	90.0	3.0	8.7	1.0	1.8	20.0	35.4	15.4		49.5	-36.1		-21.9	14.2	Max all
R11		H/V (worst case)	40.7	40.7	BICEMCO01	1.0	max all	3.0	11.5	-.4			33.1	33.1		40.0				**6.9**	background
R12		H/V (worst case)	54.2	54.2	BICEMCO01	1.0	max all	3.0	10.1	-.4			23.8	23.8		40.0				16.2	background
R13		H/V (worst case)	67.8	67.8	BICEMCO01	1.0	max all	3.0	9.7	-.4			27.7	27.7		40.0				12.3	background
R14		H/V (worst case)	81.4	81.4	BICEMCO01	1.0	max all	3.0	9.5	-.5			18.1	18.1		40.0				21.9	background
R15		H/V (worst case)	94.9	94.9	BICEMCO01	1.0	max all	3.0	9.7	-.5			37.3	38.0		43.5				5.5	background
R16		H/V (worst case)	108.5	108.5	BICEMCO01	1.0	max all	3.0	10.6	-.6			24.7	24.7		43.5				18.8	background
R17		H/V (worst case)	122.0	122.0	BICEMCO01	1.0	max all	3.0	11.7	-.6			24.0	24.0		43.5				19.5	background
R18		H/V (worst case)	135.6	135.6	BICEMCO01	1.0	max all	3.0	12.3	-.6			21.9	21.9		43.5				21.6	background
R19	CM (Small Antenna)	Coaxial - Horz	27.1	27.1	EMCOLOOP1	1.0	90.0	3.0	8.7	1.0	1.8	20.0	29.6	9.6		49.5	-41.9		-21.9	20.0	Max all
R20		H/V (worst case)	40.7	40.7	BICEMCO01	1.0	max all	3.0	11.5	-.4			34.4	34.4		40.0				**5.6**	background
R21		H/V (worst case)	54.2	54.2	BICEMCO01	1.0	max all	3.0	10.1	-.4			23.0	23.0		40.0				17.0	background
R22		H/V (worst case)	67.8	67.8	BICEMCO01	1.0	max all	3.0	9.7	-.4			25.2	25.2		40.0				14.8	background
R23		H/V (worst case)	81.4	81.4	BICEMCO01	1.0	max all	3.0	9.5	-.5			19.0	19.0		40.0				21.0	background
R24		H/V (worst case)	94.9	94.9	BICEMCO01	1.0	max all	3.0	9.7	-.5			35.8	38.0		43.5				5.5	background
R25		H/V (worst case)	108.5	108.5	BICEMCO01	1.0	max all	3.0	10.6	-.6			23.4	23.4		43.5				20.1	background
R26		H/V (worst case)	122.0	122.0	BICEMCO01	1.0	max all	3.0	11.7	-.6			21.4	21.4		43.5				22.1	background
R27		H/V (worst case)	135.6	135.6	BICEMCO01	1.0	max all	3.0	12.3	-.6			22.5	22.5		43.5				21.0	background
#	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21

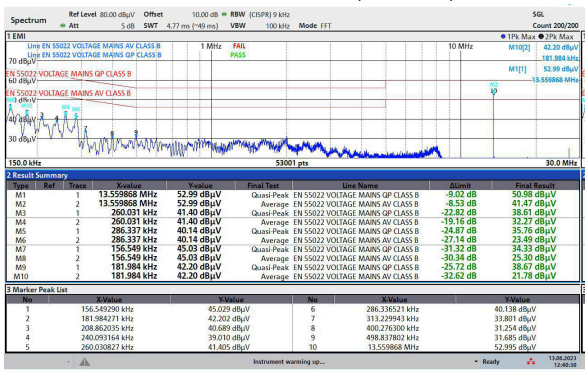
(ROW)	(COLUMN)	NOTE:
R0	C1	EUT was tested in CM (Continously Modulating) mode. No averaging applied, Peak data reported to demonstrate compliance.
R0	C11	NF/FF Boundary at lambda/2pi distance for small radiator.
R1	C12	40 dB/dec near field conversion factor, 20 dB/dec far-field conversion factors are permitted. 20dB is chosen to show compliance under worst case conversion.
R0	C13	When E-field is reported directly from Spectrum Analyzer, Antenna Factors and Cable losses are included directly in SA settings.
R0	C17	H-field is computed by subtracting dBΩ in freespace from E-Field measurements = 20*log(120π) = 51.5dB

4.3.2 Conducted Emissions Test Results - AC Power Port(s)

The results of emissions from the EUT's AC mains power port(s) are reported in Table 8.

Table 8: AC Mains Power Conducted Emissions Results.

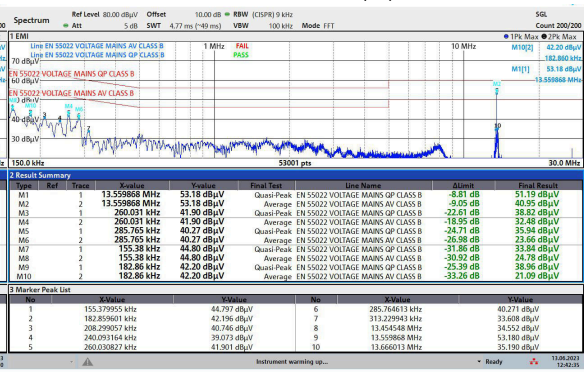
AC MAINS EMISSIONS - LARGE ANT (NEUTRAL)



Type	Ref	Trace	X-value	Y-value	Final Test	Line Name	ΔLimit	Final Result
M1		1	13.559868 MHz	52.99 dBµV	Quasi-Peak	EN 55022 VOLTAGE MAINS QP CLASS B	-9.02 dB	50.98 dBµV
M2		2	13.559868 MHz	52.99 dBµV	Average	EN 55022 VOLTAGE MAINS AV CLASS B	-8.53 dB	41.47 dBµV
M3		1	260.031 kHz	41.40 dBµV	Quasi-Peak	EN 55022 VOLTAGE MAINS QP CLASS B	-22.82 dB	38.61 dBµV
M4		2	260.031 kHz	41.40 dBµV	Average	EN 55022 VOLTAGE MAINS AV CLASS B	-19.16 dB	32.27 dBµV
M5		1	286.337 kHz	40.14 dBµV	Quasi-Peak	EN 55022 VOLTAGE MAINS QP CLASS B	-24.87 dB	35.76 dBµV
M6		2	286.337 kHz	40.14 dBµV	Average	EN 55022 VOLTAGE MAINS AV CLASS B	-27.14 dB	23.49 dBµV
M7		1	156.549 kHz	45.03 dBµV	Quasi-Peak	EN 55022 VOLTAGE MAINS QP CLASS B	-31.32 dB	34.33 dBµV
M8		2	156.549 kHz	45.03 dBµV	Average	EN 55022 VOLTAGE MAINS AV CLASS B	-30.34 dB	25.30 dBµV
M9		1	181.984 kHz	42.20 dBµV	Quasi-Peak	EN 55022 VOLTAGE MAINS QP CLASS B	-25.72 dB	38.67 dBµV
M10		2	181.984 kHz	42.20 dBµV	Average	EN 55022 VOLTAGE MAINS AV CLASS B	-32.62 dB	21.78 dBµV

No	X-Value	Y-Value	No	X-Value	Y-Value
1	156.549290 kHz	45.029 dBµV	6	286.336521 kHz	40.138 dBµV
2	181.984271 kHz	42.202 dBµV	7	313.229943 kHz	33.801 dBµV
3	208.862035 kHz	40.689 dBµV	8	400.276300 kHz	31.254 dBµV
4	240.093164 kHz	39.010 dBµV	9	498.837802 kHz	31.685 dBµV
5	260.030827 kHz	41.405 dBµV	10	13.559868 MHz	52.995 dBµV

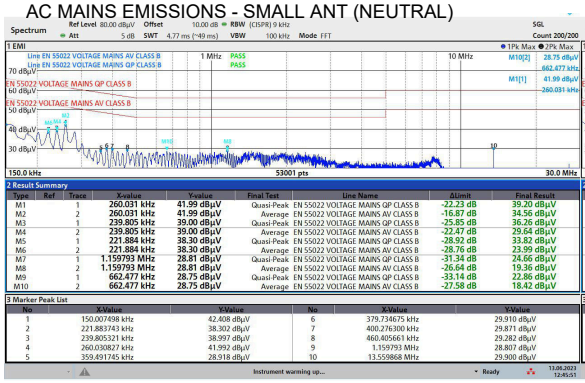
AC MAINS EMISSIONS - LARGE ANT (L1)



Type	Ref	Trace	X-value	Y-value	Final Test	Line Name	ΔLimit	Final Result
M1		1	13.559868 MHz	53.18 dBµV	Quasi-Peak	EN 55022 VOLTAGE MAINS QP CLASS B	-8.81 dB	51.19 dBµV
M2		2	13.559868 MHz	53.18 dBµV	Average	EN 55022 VOLTAGE MAINS AV CLASS B	-9.05 dB	40.95 dBµV
M3		1	260.031 kHz	41.90 dBµV	Quasi-Peak	EN 55022 VOLTAGE MAINS QP CLASS B	-22.61 dB	38.82 dBµV
M4		2	260.031 kHz	41.90 dBµV	Average	EN 55022 VOLTAGE MAINS AV CLASS B	-18.95 dB	32.48 dBµV
M5		1	285.765 kHz	40.27 dBµV	Quasi-Peak	EN 55022 VOLTAGE MAINS QP CLASS B	-24.71 dB	35.94 dBµV
M6		2	285.765 kHz	40.27 dBµV	Average	EN 55022 VOLTAGE MAINS AV CLASS B	-26.98 dB	23.66 dBµV
M7		1	155.38 kHz	44.80 dBµV	Quasi-Peak	EN 55022 VOLTAGE MAINS QP CLASS B	-31.86 dB	33.84 dBµV
M8		2	155.38 kHz	44.80 dBµV	Average	EN 55022 VOLTAGE MAINS AV CLASS B	-30.92 dB	24.78 dBµV
M9		1	182.86 kHz	42.20 dBµV	Quasi-Peak	EN 55022 VOLTAGE MAINS QP CLASS B	-25.39 dB	38.96 dBµV
M10		2	182.86 kHz	42.20 dBµV	Average	EN 55022 VOLTAGE MAINS AV CLASS B	-33.26 dB	21.09 dBµV

No	X-Value	Y-Value	No	X-Value	Y-Value
1	155.379955 kHz	44.797 dBµV	6	285.764613 kHz	40.271 dBµV
2	182.859601 kHz	42.196 dBµV	7	313.229943 kHz	33.608 dBµV
3	208.299057 kHz	40.746 dBµV	8	13.454548 MHz	34.552 dBµV
4	240.093164 kHz	39.073 dBµV	9	13.559868 MHz	53.180 dBµV
5	260.030827 kHz	41.301 dBµV	10	13.666013 MHz	35.190 dBµV

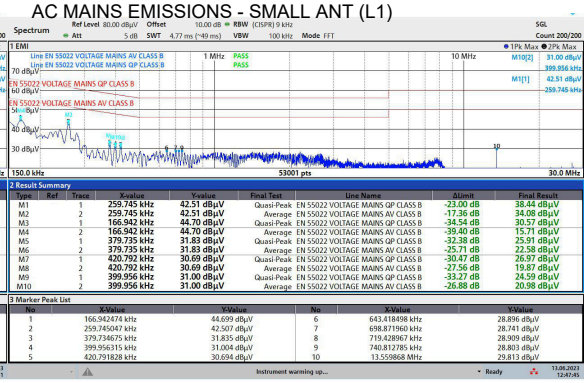
AC MAINS EMISSIONS - SMALL ANT (NEUTRAL)



Type	Ref	Trace	X-value	Y-value	Final Test	Line Name	ΔLimit	Final Result
M1		1	260.031 kHz	41.99 dBµV	Quasi-Peak	EN 55022 VOLTAGE MAINS QP CLASS B	-22.23 dB	39.20 dBµV
M2		2	260.031 kHz	41.99 dBµV	Average	EN 55022 VOLTAGE MAINS AV CLASS B	-16.87 dB	34.56 dBµV
M3		1	239.805 kHz	39.00 dBµV	Quasi-Peak	EN 55022 VOLTAGE MAINS QP CLASS B	-25.85 dB	36.26 dBµV
M4		2	239.805 kHz	39.00 dBµV	Average	EN 55022 VOLTAGE MAINS AV CLASS B	-22.47 dB	29.64 dBµV
M5		1	221.884 kHz	38.30 dBµV	Quasi-Peak	EN 55022 VOLTAGE MAINS QP CLASS B	-28.92 dB	33.82 dBµV
M6		2	221.884 kHz	38.30 dBµV	Average	EN 55022 VOLTAGE MAINS AV CLASS B	-28.76 dB	23.99 dBµV
M7		1	1.159793 MHz	28.81 dBµV	Quasi-Peak	EN 55022 VOLTAGE MAINS QP CLASS B	-31.34 dB	24.66 dBµV
M8		2	1.159793 MHz	28.81 dBµV	Average	EN 55022 VOLTAGE MAINS AV CLASS B	-26.64 dB	19.36 dBµV
M9		1	662.477 kHz	28.75 dBµV	Quasi-Peak	EN 55022 VOLTAGE MAINS QP CLASS B	-33.14 dB	22.86 dBµV
M10		2	662.477 kHz	28.75 dBµV	Average	EN 55022 VOLTAGE MAINS AV CLASS B	-27.58 dB	18.42 dBµV

No	X-Value	Y-Value	No	X-Value	Y-Value
1	150.007498 kHz	42.408 dBµV	6	379.734675 kHz	29.910 dBµV
2	221.883743 kHz	38.302 dBµV	7	400.276300 kHz	29.871 dBµV
3	239.805321 kHz	38.997 dBµV	8	460.405661 kHz	29.282 dBµV
4	260.030827 kHz	41.992 dBµV	9	1.159793 MHz	28.807 dBµV
5	359.491745 kHz	28.918 dBµV	10	13.559868 MHz	29.900 dBµV

AC MAINS EMISSIONS - SMALL ANT (L1)



Type	Ref	Trace	X-value	Y-value	Final Test	Line Name	ΔLimit	Final Result
M1		1	259.745 kHz	42.51 dBµV	Quasi-Peak	EN 55022 VOLTAGE MAINS QP CLASS B	-23.00 dB	38.44 dBµV
M2		2	259.745 kHz	42.51 dBµV	Average	EN 55022 VOLTAGE MAINS AV CLASS B	-17.36 dB	34.08 dBµV
M3		1	166.942 kHz	44.70 dBµV	Quasi-Peak	EN 55022 VOLTAGE MAINS QP CLASS B	-34.54 dB	30.57 dBµV
M4		2	166.942 kHz	44.70 dBµV	Average	EN 55022 VOLTAGE MAINS AV CLASS B	-39.40 dB	15.71 dBµV
M5		1	379.735 kHz	31.83 dBµV	Quasi-Peak	EN 55022 VOLTAGE MAINS QP CLASS B	-32.38 dB	25.91 dBµV
M6		2	379.735 kHz	31.83 dBµV	Average	EN 55022 VOLTAGE MAINS AV CLASS B	-25.71 dB	22.58 dBµV
M7		1	420.792 kHz	30.69 dBµV	Quasi-Peak	EN 55022 VOLTAGE MAINS QP CLASS B	-30.47 dB	26.97 dBµV
M8		2	420.792 kHz	30.69 dBµV	Average	EN 55022 VOLTAGE MAINS AV CLASS B	-27.56 dB	19.87 dBµV
M9		1	399.956 kHz	31.00 dBµV	Quasi-Peak	EN 55022 VOLTAGE MAINS QP CLASS B	-33.27 dB	24.59 dBµV
M10		2	399.956 kHz	31.00 dBµV	Average	EN 55022 VOLTAGE MAINS AV CLASS B	-26.88 dB	20.98 dBµV

No	X-Value	Y-Value	No	X-Value	Y-Value
1	166.942474 kHz	44.699 dBµV	6	643.418498 kHz	28.896 dBµV
2	259.745047 kHz	42.507 dBµV	7	698.871960 kHz	28.741 dBµV
3	379.734675 kHz	31.835 dBµV	8	719.428967 kHz	28.909 dBµV
4	399.956315 kHz	31.004 dBµV	9	740.817785 kHz	28.803 dBµV
5	420.791828 kHz	30.694 dBµV	10	13.559868 MHz	29.813 dBµV

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 9: 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).

2023-06-20 through 2024-06-30
Effective Dates

For the National Voluntary Laboratory Accreditation Program

Figure 9: Accreditation Documents