



FCC Test Report

FOR:

Crane Payment Innovations

Model Name:

AIO2210-US101

Product Description:

ALIO Note is a card reader bezel that incorporates mag stripe, contact, and contactless card reader capabilities in support of unattended cashless sales. It is mechanically mounted on a bill acceptor during normal use further enhancing payment capability at the POS. It utilizes 4g CAT M (Telit module ME910G1WW) cellular radio, NFC (13.56 MHz) to read cards, and BLE (QUALCOMM CSR1010) to support diagnostic capability.

FCC ID: QP8ALIONOTEVZ

Applied Rules and Standards:

47 CFR Part 15.247 (DTS)

REPORT #: EMC_MEIGR_011_21001_15.247_BT_DTS

DATE: 2021-04-23



A2LA Accredited

IC recognized #
3462B-1

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1 Assessment

The following device was evaluated against the applicable criteria specified in FCC rules Parts 15.247 of Title 47 of the Code of Federal Regulations.

No deviations were ascertained.

Company	Description	Model #
Crane Payment Innovations	ALIO Note is a card reader bezel that incorporates mag stripe, contact, and contactless card reader capabilities in support of unattended cashless sales. It is mechanically mounted on a bill acceptor during normal use further enhancing payment capability at the POS. It utilizes 4g CAT M (Telit module ME910G1WW) cellular radio, NFC (13.56 MHz) to read cards, and BLE (QUALCOMM QualCom CSR1010) to support diagnostic capability.	AIO2210-US101

Responsible for Testing Laboratory:

2021-04-23	Compliance	Kevin Wang (EMC Lab Manager)	
Date	Section	Name	Signature

Responsible for the Report:

2021-04-23	Compliance	Yuchan Lu (Test Engineer)	
Date	Section	Name	Signature

The test results of this test report relate exclusively to the test item specified in Section 3.

CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM Inc. USA.

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the EMC Test Report

Company Name:	CETECOM Inc.
Department:	Compliance
Street Address:	411 Dixon Landing Road
City/Zip Code	Milpitas, CA 95035
Country	USA
Telephone:	+1 (408) 586 6200
Fax:	+1 (408) 586 6299
EMC Lab Manager:	Kevin Wang
Responsible Project Leader:	Rami Saman

2.2 Identification of the Client

Client's Name:	Crane Payment Innovations
Street Address:	3222 Phoenixville Pike, Suite 200
City/Zip Code:	Malvern, PA 19355
Country:	USA

2.3 Identification of the Manufacturer

Manufacturer's Name:	Same as Client
Manufacturers Address:	
City/Zip Code	
Country	

3 Equipment Under Test (EUT)

3.1 EUT Specifications

Model No:	AIO2210-US101
HW Version :	G1
SW Version :	5.X
FCC-ID:	QP8ALIONOTEVZ
HVIN:	AIO2210-US101
PMN:	ALIO
Product Description:	ALIO Note is a card reader bezel that incorporates mag stripe, contact, and contactless card reader capabilities in support of unattended cashless sales. It is mechanically mounted on a bill acceptor during normal use further enhancing payment capability at the POS. It utilizes 4g CAT M (Telit module ME910G1WW) cellular radio, NFC (13.56 MHz) to read cards, and BLE (QUALCOMM CSR1010) to support diagnostic capability.
Frequency Range / number of channels:	Manufacture: Qualcomm Module name/number: CRS 1010 QFN Nominal band: 2400 MHz – 2483.5 MHz; Center to center: 2402 MHz (ch 0) – 2480 MHz (ch 39), 40 channels
Type(s) of Modulation:	Bluetooth Low Energy, using Dynamic Sequence Spread Spectrum with GFSK modulation.
Modes of Operation:	Bluetooth LE in both advertising and connected mode of operation
Antenna Information as declared:	1.8 dBi
Max. Peak Output Power:	Conducted Power 9.4 dBm
Power Supply/ Rated Operating Voltage Range:	Vmin: 20 VDC/ Vnom: 24 VDC / Vmax: 42 VDC
Operating Temperature Range:	Low -15°C, Nominal 25°C, High 60°C
Other Radios included in the device:	❖ <u>LTE</u> • Manufacture: Telit • Module name/number: ME910G1-WW • FCC ID: RI7ME910G1WW ❖ <u>BLE</u> • Manufacture: Qualcomm • Module name/number: CRS 1010 QFN ❖ <u>NFC</u>

	• Manufacture: ST • Module name/number: ST25R3911B
Sample Revision:	☐ Prototype Unit; ☒ Production Unit; ☐ Pre-Production

3.2 EUT Sample details

EUT #	Sample Number	HW Version	SW Version	Notes/Comments
1	42000000152	G1	5.X	Radiated Emissions

3.3 Accessory Equipment details

AE #	Type	Manufacture	Model	P/N
1	Switching Adapter	Sunny Computer Technology	SYS1548-6524-T2	G160305126068
2	Vending demo tester	-	-	-
3	RXIA PCB	-	-	-

3.4 Support Equipment

SE #	Description
1	Router, Manufacture: tp-link, Model: TL-WR841N
2	BLE interface PCB
3	Laptop, Manufacture: DELL, Model: Latitude E5470

3.5 Test Sample Configuration

EUT Set-up #	Combination of AE used for test set up	Comments
1	EUT#1 + AE#1 + AE#2 + AE#3	Special commands through "uEnergy" app and Putty used to configure the Bluetooth LE radio to low, mid and high channels and co-transmitting with LTE CAT M1 Band 4 mid Channel (1732.5 MHz) provided by the client that will not be available to the end user. For radiated measurements, the internal antenna was connected.

3.6 Justification for Worst Case Mode of Operation

During the testing process, the EUT was tested with transmitter sets on low, mid and high channels, and co-transmitting with LTE CAT M1 Band 4 mid Channel (1732.5 MHz). Based on client declaration, the EUT was configured to the highest duty cycle and maximum output power.

For radiated measurements, all data in this report shows the worst case between horizontal and vertical antenna polarizations and for all orientations of the EUT.

4 Subject of Investigation

The objective of the measurements done by CETECOM Inc. was to assess the performance of the EUT according to the relevant requirements specified in FCC rules Part 15.247 of Title 47 of the Code of Federal Regulations.

Testing procedures are based on 558074 D01 DTS Meas Guidance v05r02 – “GUIDANCE FOR PERFORMING COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEMS (DTS) OPERATING UNDER SECTION 15.247” - April 2, 2019, by the Federal Communications Commission, Office of Engineering and Technology, Laboratory Division.

5 Measurement Results Summary

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	NA	NP	Result
§15.247(a)(1)	Emission Bandwidth	Nominal	BTLE	☐	☐	☒	Complies
§15.247(e)	Power Spectral Density	Nominal	BTLE	☐	☐	☒	Complies
§15.247(b)(1)	Maximum Conducted Output Power and EIRP	Nominal	BTLE	☐	☐	☒	Complies
§15.247(d)	Band edge compliance Unrestricted Band Edges	Nominal	BTLE	☐	☐	☒	Complies
§15.247; 15.209; 15.205	Band edge compliance Restricted Band Edges	Nominal	BTLE	☐	☐	☒	Complies
§15.247(d); §15.209	TX Spurious emissions- Radiated	Nominal	BTLE	☒	☐	☐	Complies
§15.207(a)	AC Conducted Emissions	Nominal	BTLE	☒	☐	☐	Complies

Note1: NA= Not Applicable; NP= Not Performed.

Note2: Test result are leveraged from report “EMC_MEIGR_008_15.247_DTS”. Refer to section 3.5 for justification

6 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus, with 95% confidence interval (in dB delta to result), based on a coverage factor $k=1$.

Radiated measurement

9 kHz to 30 MHz	± 2.5 dB (Magnetic Loop Antenna)
30 MHz to 1000 MHz	± 2.0 dB (Biconilog Antenna)
1 GHz to 40 GHz	± 2.3 dB (Horn Antenna)

Conducted measurement

150 kHz to 30 MHz	± 0.7 dB (LISN)
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RF conducted measurement	± 0.5 dB
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According to TR 102 273 a multiplicative propagation of error is assumed for RF measurement systems. For this reason the RMS method is applied to dB values and not to linear values as appropriate for additive propagation of error. Also used: <http://physics.nist.gov/cuu/Uncertainty/typeb.html>. The above calculated uncertainties apply to direct application of the Substitution method. The Substitution method is always used when the EUT comes closer than 3 dB to the limit.

6.1 Environmental Conditions during Testing:

The following environmental conditions were maintained during the course of testing:

- Ambient Temperature: 20-25° C
- Relative humidity: 40-60%

6.2 Dates of Testing:

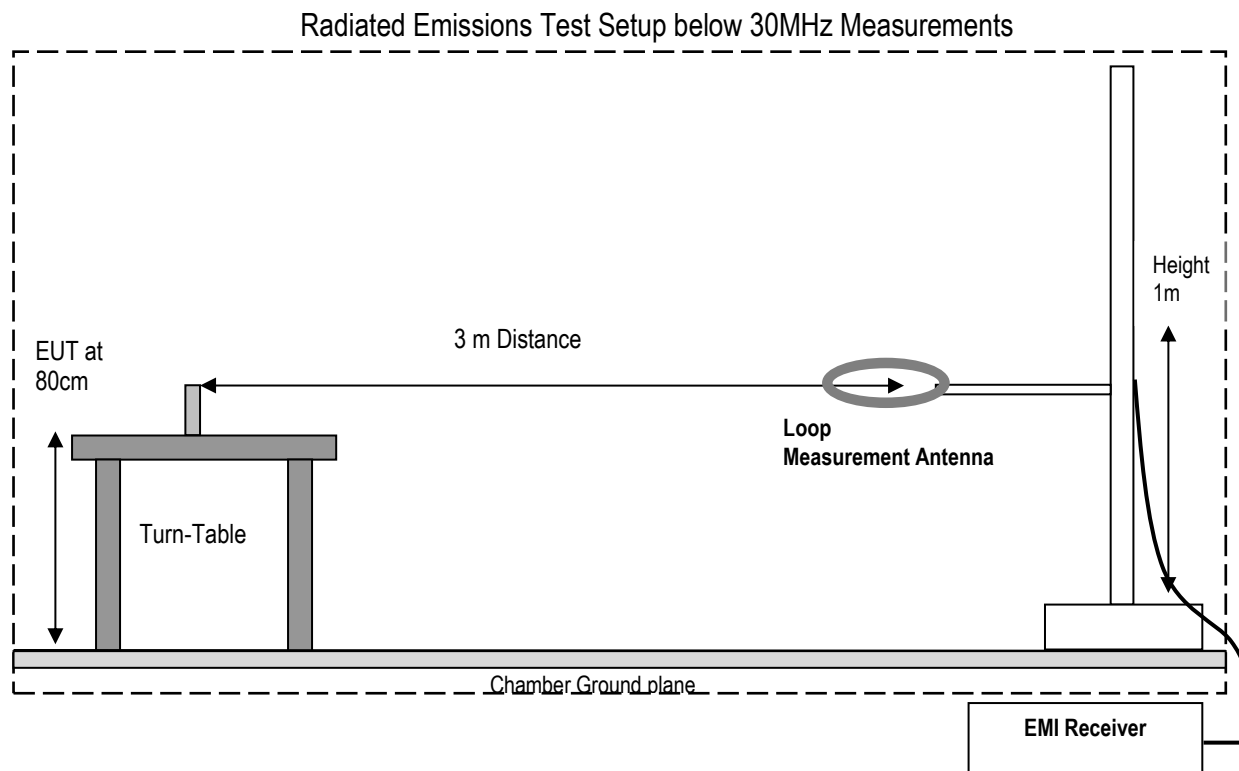
03/11/2021-03/16/2021

7 Measurement Procedures

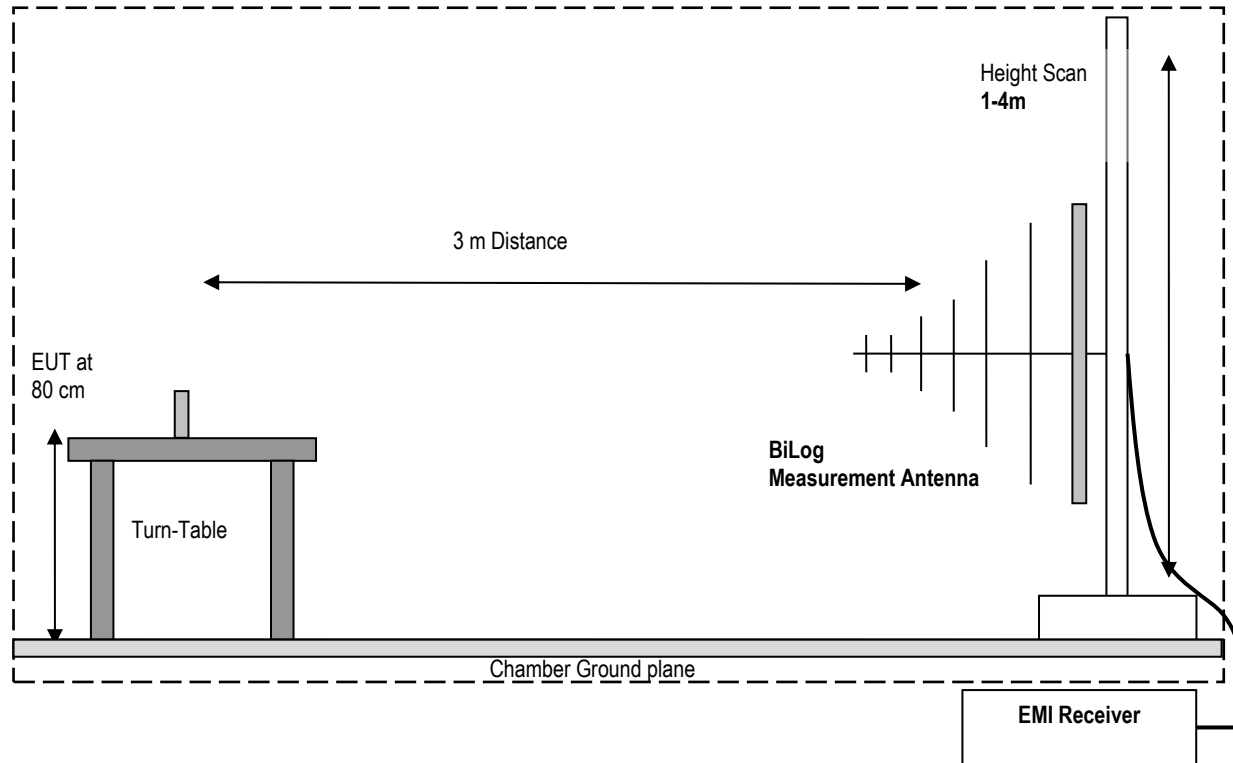
7.1 Radiated Measurement

The radiated measurement is performed according to ANSI C63.10 (2013)

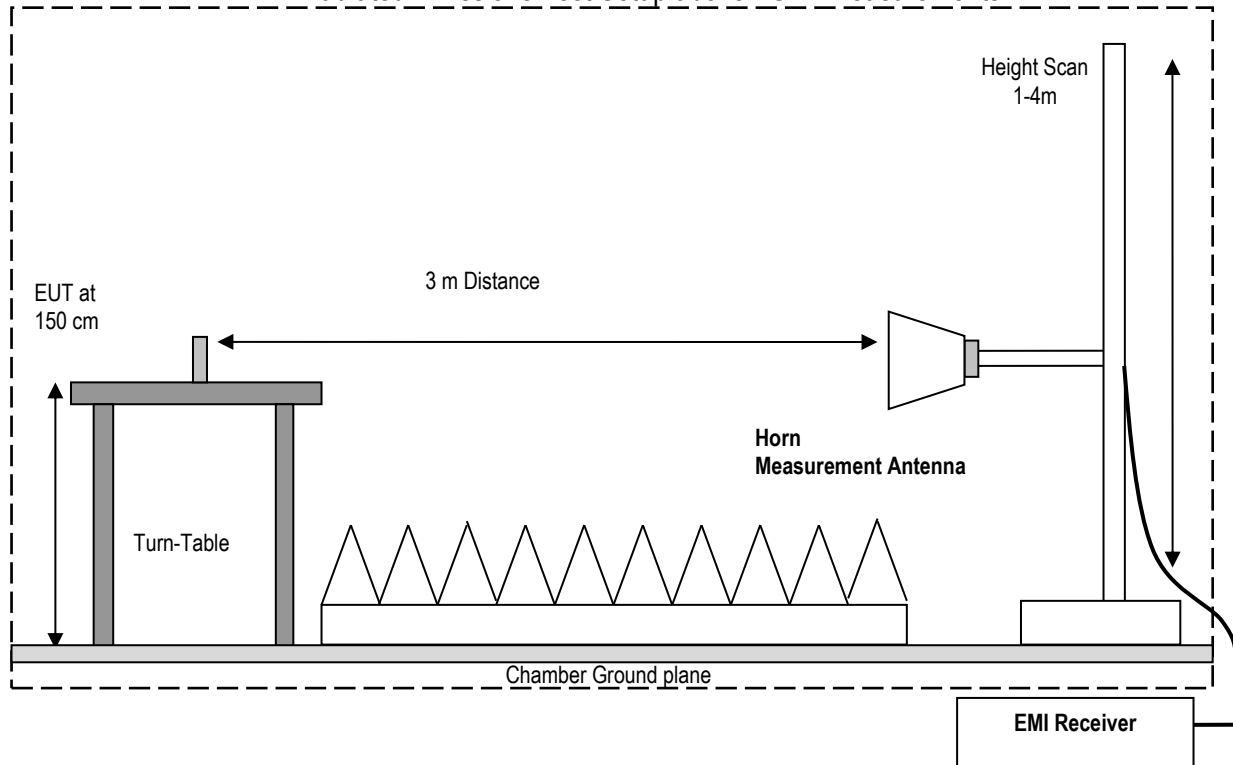
- The exploratory measurement is accomplished by running a matrix of 16 sweeps over the required frequency range with R&S Test-SW EMC32 for 4 positions of the turntable, two orthogonal positions of the EUT and both antenna polarizations. This procedure exceeds the requirement of the above standards to cover the 3 orthogonal axis of the EUT. A max peak detector is utilized during the exploratory measurement. The Test-SW creates an overall maximum trace for all 12 sweeps and saves the settings for each point of this trace. The maximum trace is part of the test report.
- The 10 highest emissions are selected with an automatic algorithm of EMC32 searching for peaks in the noise floor and ensuring that broadband signals are not selected multiple times.
- The maxima are then put through the final measurement and again maximized in a 90deg range of the turntable, fine search in frequency domain and height scan between 1m and 4m.
- The above procedure is repeated for all possible ways of power supply to EUT and for all supported modulations.
- In case there are no emissions above noise floor level only the maximum trace is reported as described above.
- The results are split up into up to 4 frequency ranges due to antenna bandwidth restrictions. A magnetic loop is used from 9 kHz to 30 MHz, a Biconilog antenna is used from 30 MHz to 1 GHz, and two different horn antennas are used to cover frequencies up to 40 GHz.



Radiated Emissions Test Setup 30MHz-1GHz Measurements



Radiated Emissions Test Setup above 1GHz Measurements



7.1.1 Sample Calculations for Field Strength Measurements

Field Strength is calculated from the Spectrum Analyzer/ Receiver readings, taking into account the following parameters:

1. Measured reading in dB μ V
2. Cable Loss between the receiving antenna and SA in dB and
3. Antenna Factor in dB/m

All radiated measurement plots in this report are taken from a test SW that calculates the Field Strength based on the following equation:

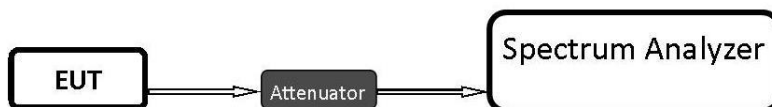
$$FS \text{ (dB}\mu\text{V/m)} = \text{Measured Value on SA (dB}\mu\text{V)} + \text{Cable Loss (dB)} + \text{Antenna Factor (dB/m)}$$

Example:

Frequency (MHz)	Measured SA (dB μ V)	Cable Loss (dB)	Antenna Factor Correction (dB)	Field Strength Result (dB μ V/m)
1000	80.5	3.5	14	98.0

7.2 RF Conducted Measurement Procedure

Testing procedures are based on 558074 D01 DTS Meas Guidance v05r02 – “GUIDANCE FOR PERFORMING COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEMS (DTS) OPERATING UNDER SECTION 15.247” - April 2, 2019, by the Federal Communications Commission, Office of Engineering and Technology, Laboratory Division.



- Connect the equipment as shown in the above diagram.
- Adjust the settings of the SA (Rohde-Schwarz Spectrum Analyzer) to connect the EUT at the required mode of test.
- Measurements are to be performed with the EUT set to the low, middle and high channels and for worst case modulation schemes.
- Calculate the conducted power by taking into account attenuation of the cable and the attenuator

8 Test Result Data

8.1 Radiated Transmitter Spurious Emissions and Restricted Bands

8.1.1 Measurement according to ANSI C63.10 (2013)

Spectrum Analyzer Settings:

- Frequency = 9 KHz – 30 MHz
- RBW = 9 KHz
- Detector: Peak

- Frequency = 30 MHz – 1 GHz
- Detector = Peak / Quasi-Peak
- RBW= 120 KHz (<1GHz)

- Frequency > 1 GHz
- Detector = Peak / Average
- RBW = 1 MHz

- Radiated spurious emissions shall be measured for the transmit frequencies, transmit power, and data rate for the lowest, middle and highest channel in each frequency band of operation and for the highest gain antenna for each antenna type, and using the appropriate parameters and test requirements.
- The highest (or worst-case) data rate shall be recorded for each measurement.
- For testing at distance other than the specified in the standard, the limit conversion is calculated by using 40 dB/decade extrapolation factor as follow: Conversion factor (CF) = $40 \log (D/d) = 40 \log (300\text{m} / 3\text{m}) = 80\text{dB}$

8.1.2 Limits:

FCC §15.247

- In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

FCC §15.209

- Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency of emission (MHz)	Field strength (μV/m)	Measurement Distance (m)	Field strength @ 3m (dBμV/m)
0.009–0.490	2400/F(kHz) / -----	300	-
0.490–1.705	24000/F(kHz) / -----	30	-
1.705–30.0	30 / (29.5)	30	-
30–88	100	3	40 dBμV/m
88–216	150	3	43.5 dBμV/m
216–960	200	3	46 dBμV/m
Above 960	500	3	54 dBμV/m

FCC §15.205

- Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
10.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41			

- Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

*PEAK LIMIT= 74 dBμV/m

*AVG. LIMIT= 54 dBμV/m

8.1.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
23° C	1	GFSK continuous fixed channel	110 VAC

8.1.4 Measurement result:

Plot #	Channel #	Scan Frequency	Limit	Result
1-3	Low	30 MHz – 18 GHz	See section 8.1.2	Pass
4-8	Mid	9 kHz – 26 GHz	See section 8.1.2	Pass
9-11	High	30 MHz – 18 GHz	See section 8.1.2	Pass

8.1.5 Measurement Plots:

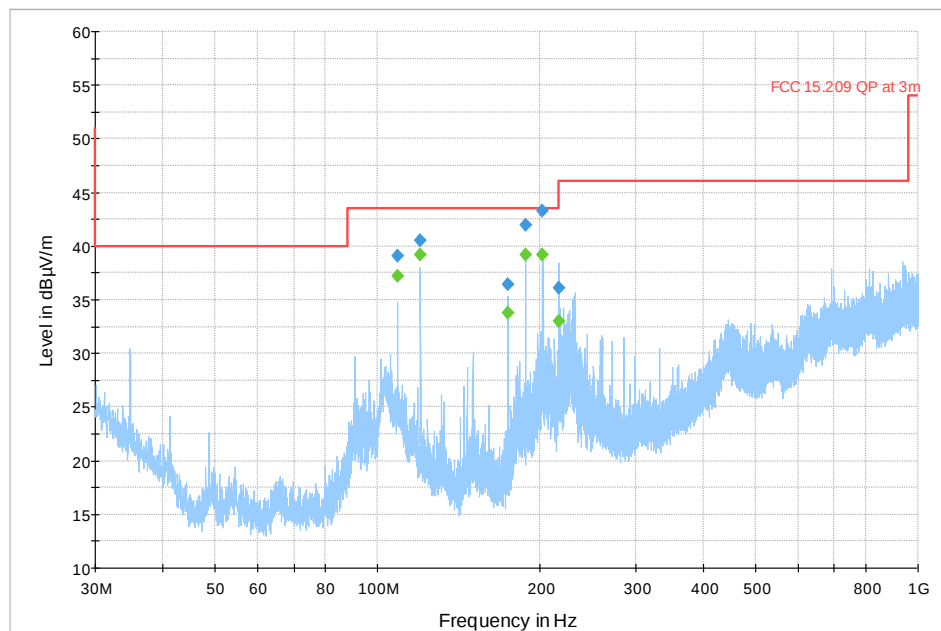
Plot #1 Radiated Emissions: 30 MHz – 1GHz

Modulation: BT LE

Channel: Low

Final Result

Frequency (MHz)	MaxPeak (dBμV/m)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
108.732	39.10	---	43.50	4.40	500.0	120.000	268.0	H	203.0	13.2	
108.732	---	37.23	---	---	500.0	120.000	268.0	H	203.0	13.2	
119.984	40.49	---	43.50	3.01	500.0	120.000	236.0	H	-8.0	12.7	
119.984	---	39.22	---	---	500.0	120.000	236.0	H	-8.0	12.7	
174.174	---	33.81	---	---	500.0	120.000	197.0	H	266.0	14.2	
174.174	36.42	---	43.50	7.08	500.0	120.000	197.0	H	266.0	14.2	
188.142	---	39.18	---	---	500.0	120.000	150.0	H	232.0	14.3	
188.142	41.92	---	43.50	1.58	500.0	120.000	150.0	H	232.0	14.3	
202.046	---	39.22	---	---	500.0	120.000	173.0	H	241.0	15.0	
202.046	43.26	---	43.50	0.24	500.0	120.000	173.0	H	241.0	15.0	
215.981	---	32.96	---	---	500.0	120.000	186.0	H	289.0	15.4	
215.981	36.12	---	43.50	7.38	500.0	120.000	186.0	H	289.0	15.4	



Preview Result 2-QPK Final_Result PK+ Preview Result 1-PK+ Final_Result QPK FCC 15.209 QP at 3m

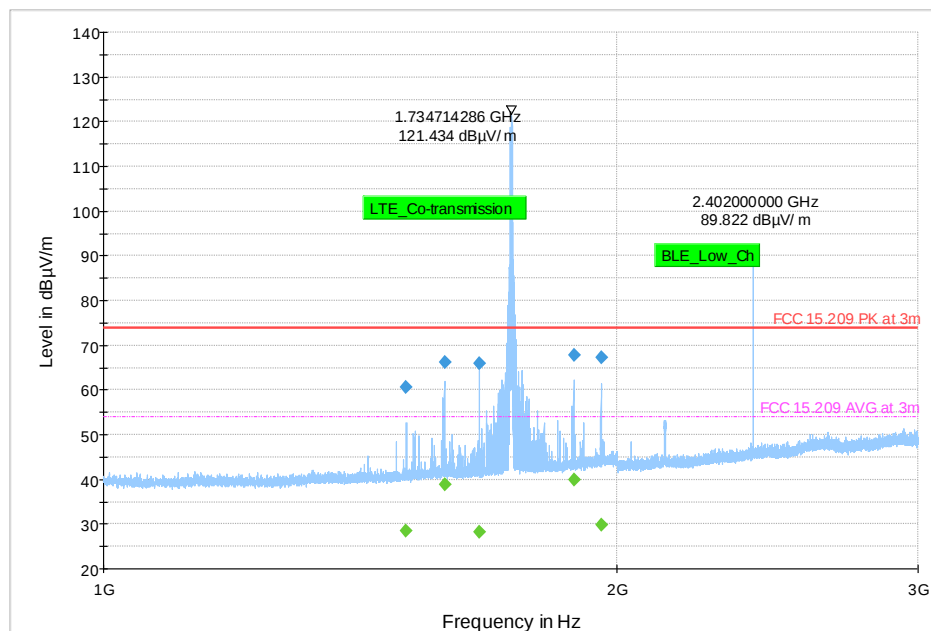
Plot #2 Radiated Emissions: 1-3 GHz

Modulation: BT LE

Channel: Low

Final Result

Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
1504.571	---	28.38	53.98	25.60	500.0	1000.000	229.0	H	303.0	5.3	
1504.571	60.73	---	73.98	13.25	500.0	1000.000	229.0	H	303.0	5.3	
1583.714	66.09	---	73.98	7.89	500.0	1000.000	140.0	H	101.0	5.8	
1583.714	---	38.78	53.98	15.20	500.0	1000.000	140.0	H	101.0	5.8	
1659.286	65.80	---	73.98	8.18	500.0	1000.000	140.0	V	22.0	6.1	
1659.286	---	28.28	53.98	25.70	500.0	1000.000	140.0	V	22.0	6.1	
1885.429	67.86	---	73.98	6.12	500.0	1000.000	315.0	H	150.0	7.5	
1885.429	---	39.79	53.98	14.19	500.0	1000.000	315.0	H	150.0	7.5	
1956.143	67.35	---	73.98	6.63	500.0	1000.000	152.0	H	126.0	7.7	
1956.143	---	29.86	53.98	24.12	500.0	1000.000	152.0	H	126.0	7.7	



Preview Result 2-QPK Preview Result 1-PK+ FCC 15.209 PK at 3m
FCC 15.209 AVG at 3m Final_Result PK+ Final_Result CAV

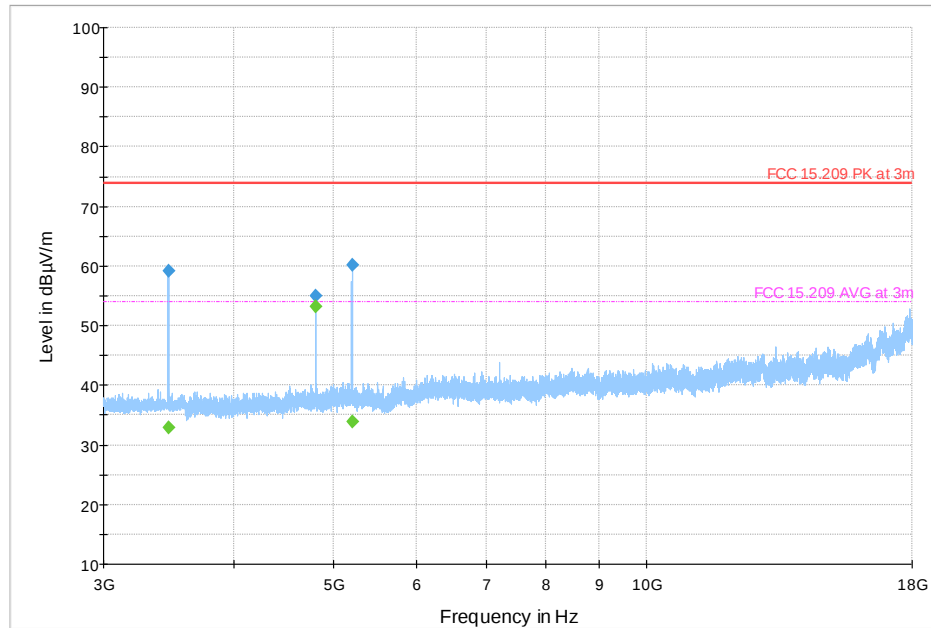
Plot #3 Radiated Emissions: 3-18 GHz

Modulation: BT LE

Channel: Low

Final Result

Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
3469.000	59.15	---	73.98	14.83	500.0	1000.000	176.0	H	81.0	-7.9	
3469.000	---	32.98	53.98	21.00	500.0	1000.000	176.0	H	81.0	-7.9	
4804.000	54.93	---	73.98	19.05	500.0	1000.000	140.0	H	249.0	-4.8	
4804.000	---	53.31	53.98	0.67	500.0	1000.000	140.0	H	249.0	-4.8	
5204.000	---	33.87	53.98	20.11	500.0	1000.000	140.0	H	54.0	-4.0	
5204.000	60.21	---	73.98	13.77	500.0	1000.000	140.0	H	54.0	-4.0	



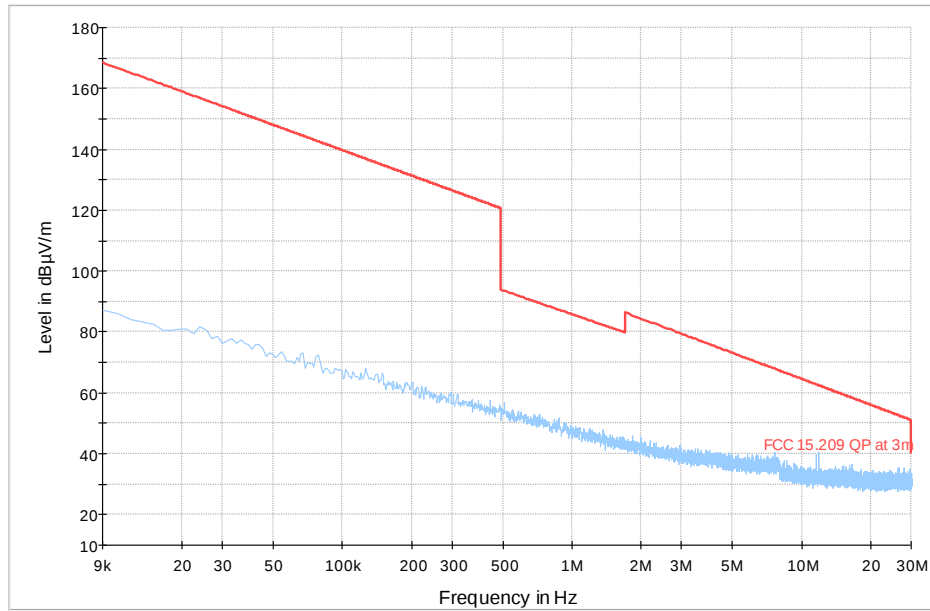
Preview Result 2-QPK Preview Result 1-PK+ FCC 15.209 PK at 3m
FCC 15.209 AVG at 3m Final_Result PK+ Final_Result CAV

Note: According to FCC15.35(c), a duty cycle correction factor is applied here. Considering the limit of packets per interval and minimum interval of BTLE, this leads a correction factor of 17.86dB. Hence this margin would cover the highest spurious above.

Plot #4 Radiated Emissions: 9 KHz – 30 MHz

Modulation: BT LE

Channel: Mid



Preview Result 2-QPK Preview Result 1-PK+ Critical_Freqs QPK
* Critical_Freqs PK+ FCC 15.209 QP at 3m Final_Result PK+
◆ Final_Result QPK

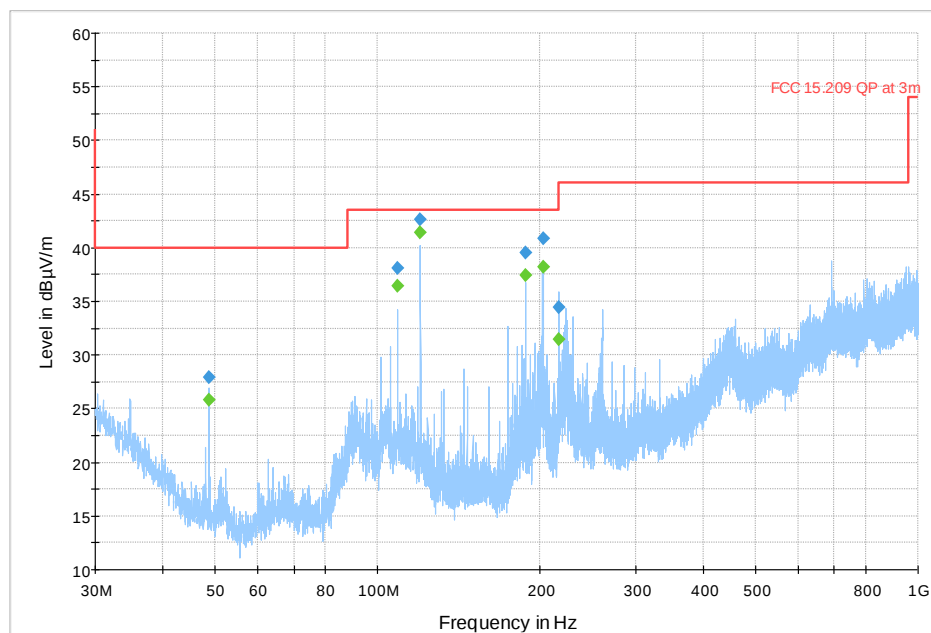
Plot #5 Radiated Emissions: 30 MHz – 1GHz

Modulation: BT LE

Channel: Mid

Final Result

Frequency (MHz)	MaxPeak (dBμV/m)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
48.753	27.88	---	40.00	12.12	500.0	120.000	140.0	V	305.0	10.6	
48.753	---	25.80	---	---	500.0	120.000	140.0	V	305.0	10.6	
108.732	---	36.43	---	---	500.0	120.000	252.0	H	17.0	13.2	
108.732	38.09	---	43.50	5.41	500.0	120.000	252.0	H	17.0	13.2	
120.016	42.58	---	43.50	0.92	500.0	120.000	208.0	H	217.0	12.7	
120.016	---	41.37	---	---	500.0	120.000	208.0	H	217.0	12.7	
188.110	---	37.44	---	---	500.0	120.000	164.0	H	267.0	14.3	
188.110	39.58	---	43.50	3.92	500.0	120.000	164.0	H	267.0	14.3	
202.078	---	38.21	---	---	500.0	120.000	140.0	H	237.0	15.0	
202.078	40.90	---	43.50	2.60	500.0	120.000	140.0	H	237.0	15.0	
215.981	---	31.43	---	---	500.0	120.000	315.0	H	196.0	15.4	
215.981	34.44	---	43.50	9.06	500.0	120.000	315.0	H	196.0	15.4	



Preview Result 2-QPK Final_Result PK+ Preview Result 1-PK+ Final_Result QPK FCC 15.209 QP at 3m

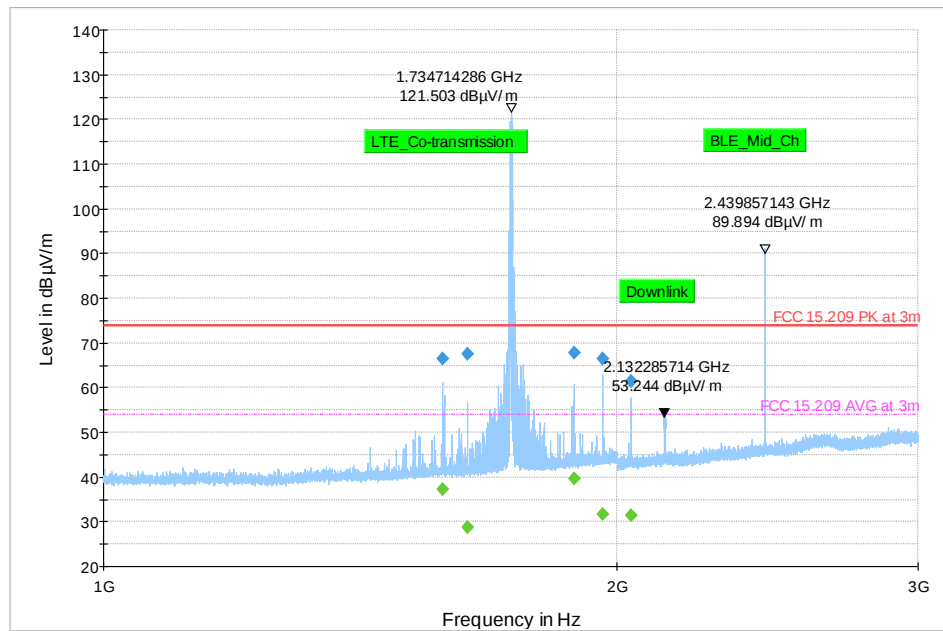
Plot #6 Radiated Emissions: 1-3 GHz

Modulation: BT LE

Channel: Mid

Final Result

Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
1580.000	66.39	---	73.98	7.59	500.0	1000.000	254.0	H	98.0	5.8	
1580.000	---	37.34	53.98	16.64	500.0	1000.000	254.0	H	98.0	5.8	
1633.857	---	28.78	53.98	25.20	500.0	1000.000	301.0	H	90.0	5.9	
1633.857	67.64	---	73.98	6.34	500.0	1000.000	301.0	H	90.0	5.9	
1885.429	67.80	---	73.98	6.18	500.0	1000.000	152.0	H	149.0	7.5	
1885.429	---	39.54	53.98	14.44	500.0	1000.000	152.0	H	149.0	7.5	
1960.857	66.53	---	73.98	7.45	500.0	1000.000	152.0	H	128.0	7.8	
1960.857	---	31.79	53.98	22.19	500.0	1000.000	152.0	H	128.0	7.8	
2036.143	61.33	---	73.98	12.65	500.0	1000.000	140.0	H	105.0	8.2	
2036.143	---	31.55	53.98	22.43	500.0	1000.000	140.0	H	105.0	8.2	



Preview Result 2-QPK Preview Result 1-PK+ FCC 15.209 PK at 3m
FCC 15.209 AVG at 3m Final_Result PK+ Final_Result CAV

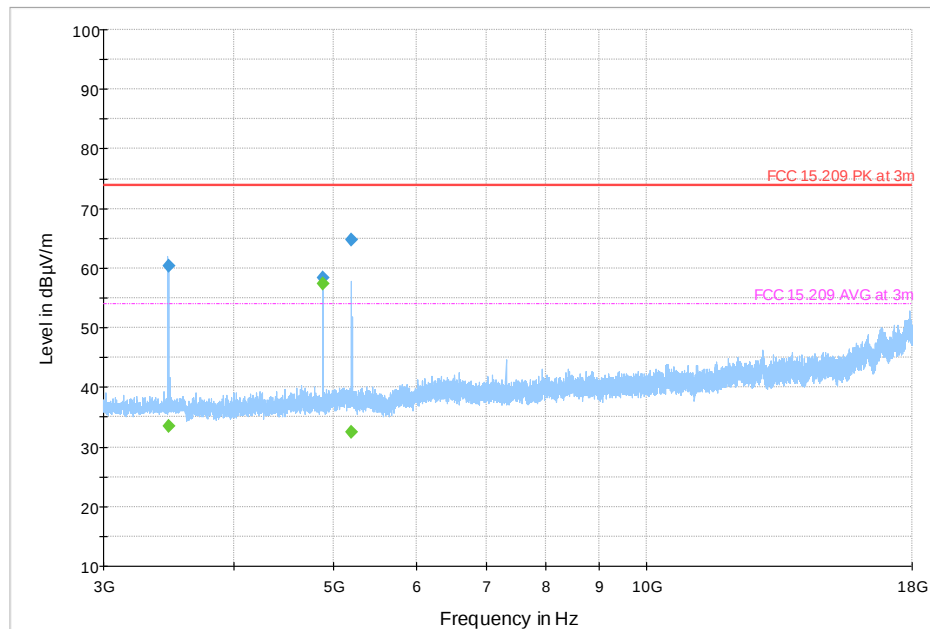
Plot #7 Radiated Emissions: 3-18 GHz

Modulation: BT LE

Channel: Mid

Final Result

Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
3469.000	60.36	---	73.98	13.62	500.0	1000.000	140.0	V	204.0	-7.9	
3469.000	---	33.59	53.98	20.39	500.0	1000.000	140.0	V	204.0	-7.9	
4880.000	58.45	---	73.98	15.53	500.0	1000.000	218.0	H	247.0	-5.0	
4880.000	---	57.42	53.98	-3.44	500.0	1000.000	218.0	H	247.0	-5.0	
5191.500	64.84	---	73.98	9.14	500.0	1000.000	265.0	H	289.0	-3.9	
5191.500	---	32.55	53.98	21.43	500.0	1000.000	265.0	H	289.0	-3.9	



— Preview Result 2-QPK — Preview Result 1-PK+ — FCC 15.209 PK at 3m
— FCC 15.209 AVG at 3m ◆ Final_Result PK+ ◆ Final_Result CAV

Note: According to FCC15.35(c), a duty cycle correction factor is applied here. Considering the limit of packets per interval and minimum interval of BTLE, this leads a correction factor of 17.86dB. Hence this margin would cover the highest spurious above.

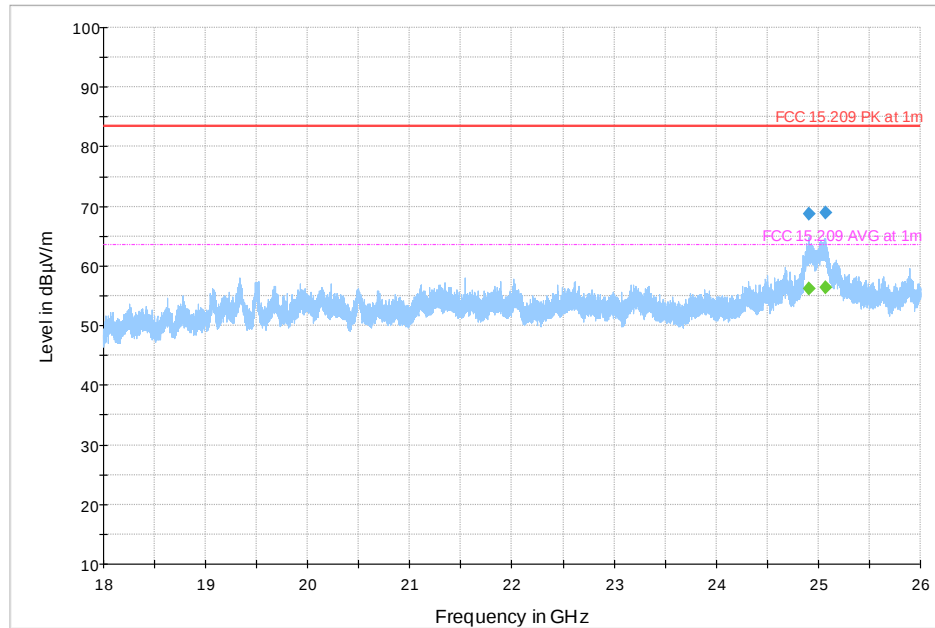
Plot #8 Radiated Emissions: 18-26 GHz

Modulation: BT LE

Channel: Mid

Final Result

Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
24905.719	---	56.21	63.50	7.29	500.0	1000.000	100.0	H	115.0	30.2	
24905.719	68.65	---	83.50	14.85	500.0	1000.000	100.0	H	115.0	30.2	
25076.516	---	56.32	63.50	7.18	500.0	1000.000	100.0	H	212.0	30.2	
25076.516	68.89	---	83.50	14.61	500.0	1000.000	100.0	H	212.0	30.2	



Preview Result 2-QPK Preview Result 1-PK+ FCC 15.209 PK at 1m
FCC 15.209 AVG at 1m Final_Result PK+ Final_Result CAV

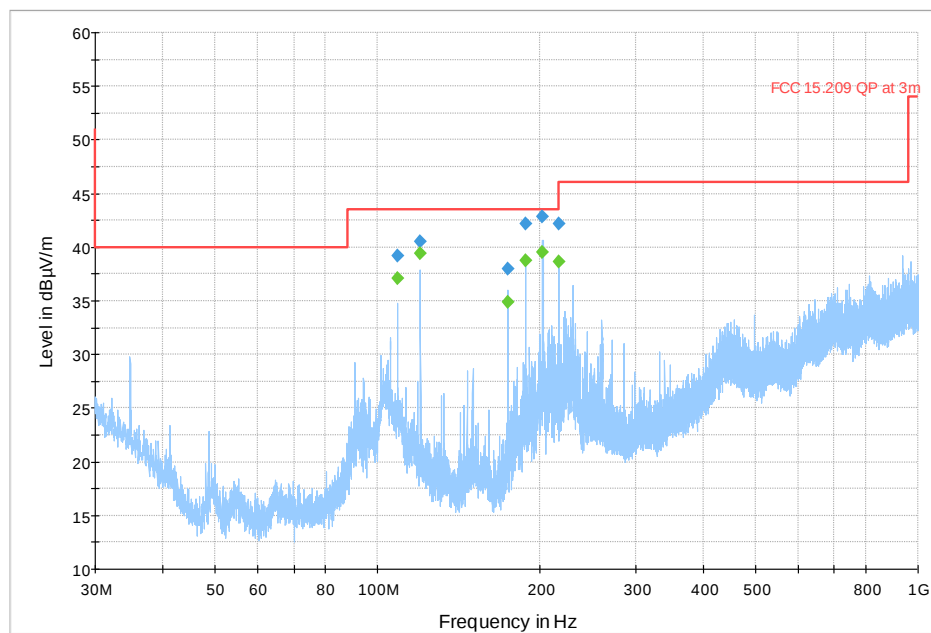
Plot #9 Radiated Emissions: 30 MHz – 1GHz

Modulation: BT LE

Channel: High

Final Result

Frequency (MHz)	MaxPeak (dBμV/m)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
108.732	---	37.08	---	---	500.0	120.000	269.0	H	201.0	13.2	
108.732	39.23	---	43.50	4.27	500.0	120.000	269.0	H	201.0	13.2	
120.016	---	39.39	---	---	500.0	120.000	287.0	H	347.0	12.7	
120.016	40.51	---	43.50	2.99	500.0	120.000	287.0	H	347.0	12.7	
174.174	37.98	---	43.50	5.52	500.0	120.000	210.0	H	229.0	14.2	
174.174	---	34.92	---	---	500.0	120.000	210.0	H	229.0	14.2	
188.110	42.15	---	43.50	1.35	500.0	120.000	163.0	H	240.0	14.3	
188.110	---	38.78	---	---	500.0	120.000	163.0	H	240.0	14.3	
202.046	---	39.59	---	---	500.0	120.000	151.0	H	242.0	15.0	
202.046	42.87	---	43.50	0.63	500.0	120.000	151.0	H	242.0	15.0	
215.981	---	38.67	---	---	500.0	120.000	140.0	H	255.0	15.4	
215.981	42.23	---	43.50	1.27	500.0	120.000	140.0	H	255.0	15.4	



Preview Result 2-QPK
Preview Result 1-PK+
Final Result QPK

FCC 15.209 QP at 3m

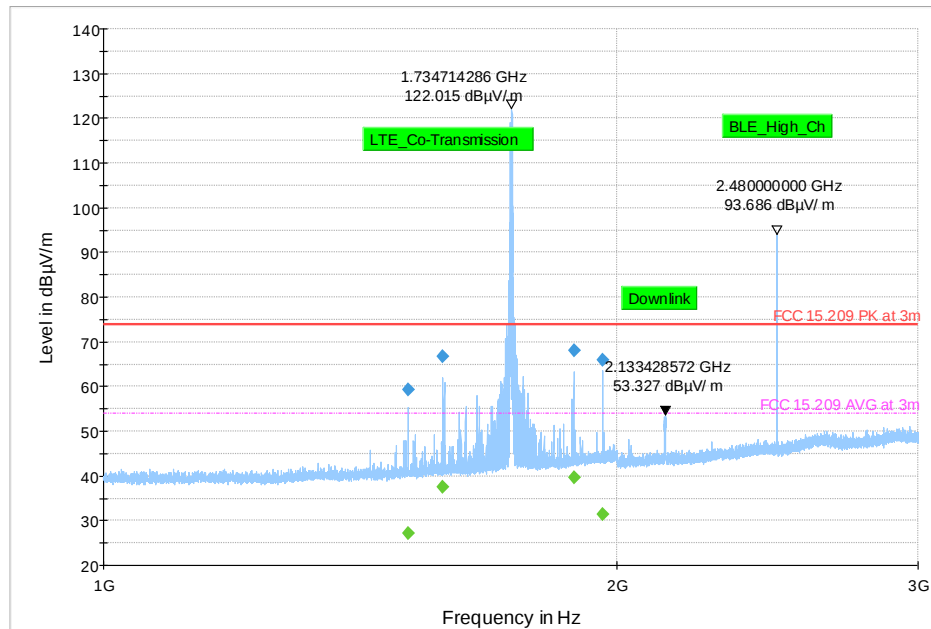
Plot #10 Radiated Emissions: 1-3 GHz

Modulation: BT LE

Channel: High

Final Result

Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
1508.429	---	27.17	53.98	26.81	500.0	1000.000	297.0	V	71.0	5.3	
1508.429	59.27	---	73.98	14.71	500.0	1000.000	297.0	V	71.0	5.3	
1580.000	66.64	---	73.98	7.34	500.0	1000.000	315.0	H	104.0	5.8	
1580.000	---	37.52	53.98	16.46	500.0	1000.000	315.0	H	104.0	5.8	
1885.571	---	39.65	53.98	14.33	500.0	1000.000	315.0	H	146.0	7.5	
1885.571	67.98	---	73.98	6.00	500.0	1000.000	315.0	H	146.0	7.5	
1960.714	65.83	---	73.98	8.15	500.0	1000.000	140.0	H	153.0	7.8	
1960.714	---	31.39	53.98	22.59	500.0	1000.000	140.0	H	153.0	7.8	



Preview Result 2-QPK
FCC 15.209 AVG at 3m

Preview Result 1-PK+
Final_Result PK+

FCC 15.209 PK at 3m
Final_Result CAV

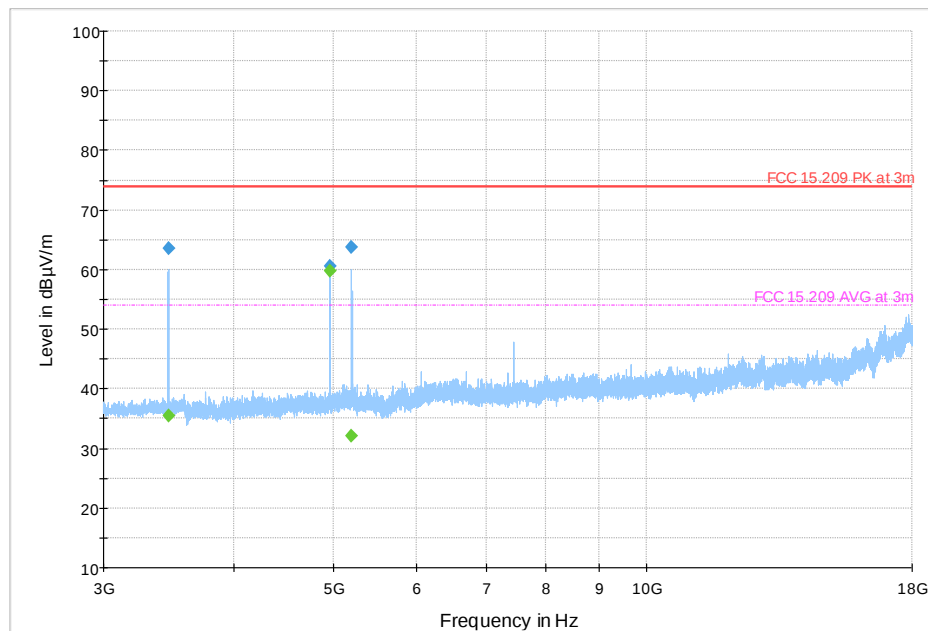
Plot #11 Radiated Emissions: 3-18 GHz

Modulation: BTLE

Channel: High

Final Result

Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
3469.000	---	35.59	53.98	18.39	500.0	1000.000	152.0	H	182.0	-7.9	
3469.000	63.55	---	73.98	10.43	500.0	1000.000	152.0	H	182.0	-7.9	
4960.000	60.57	---	73.98	13.41	500.0	1000.000	243.0	H	244.0	-4.5	
4960.000	---	59.77	53.98	-5.79	500.0	1000.000	243.0	H	244.0	-4.5	
5191.000	---	32.08	53.98	21.90	500.0	1000.000	232.0	H	289.0	-3.9	
5191.000	63.77	---	73.98	10.21	500.0	1000.000	232.0	H	289.0	-3.9	



Preview Result 2-QPK Preview Result 1-PK+ FCC 15.209 PK at 3m
FCC 15.209 AVG at 3m Final_Result PK+ Final_Result CAV

Note: According to FCC15.35(c), a duty cycle correction factor is applied here. Considering the limit of packets per interval and minimum interval of BTLE, this leads a correction factor of 17.86dB. Hence this margin would cover the highest spurious above.

8.2 AC Power Line Conducted Emissions

8.2.1 Measurement according to ANSI C63.10 (2013)

Analyzer Settings:

- RBW = 9 KHz (CISPR Bandwidth)
- Pre-scan Detector = Peak / Average for
- Final Measurements Detector = Quasi-Peak / Average

8.2.2 Limits: FCC 15.207

(a) Except as shown in paragraphs (b) and (c) of this section of the CFR, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table (1), as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between frequency ranges.

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

*Decreases with the logarithm of the frequency.

8.2.3 Test conditions and setup:

Ambient Temperature (C)	EUT Set-Up #	EUT operating mode	Power line (L1, L2, L3, N)	Power Input
22	1	GFSK continuous fixed channel	Line & Neutral	110 V / 60 Hz

8.2.4 Measurement Result:

Plot #	Port	EUT Set-Up #	EUT operating mode	Scan Frequency	Limit	Result
1	AC Mains	1	GFSK continuous fixed channel	150 kHz – 30 MHz	See section 8.2.2	Pass

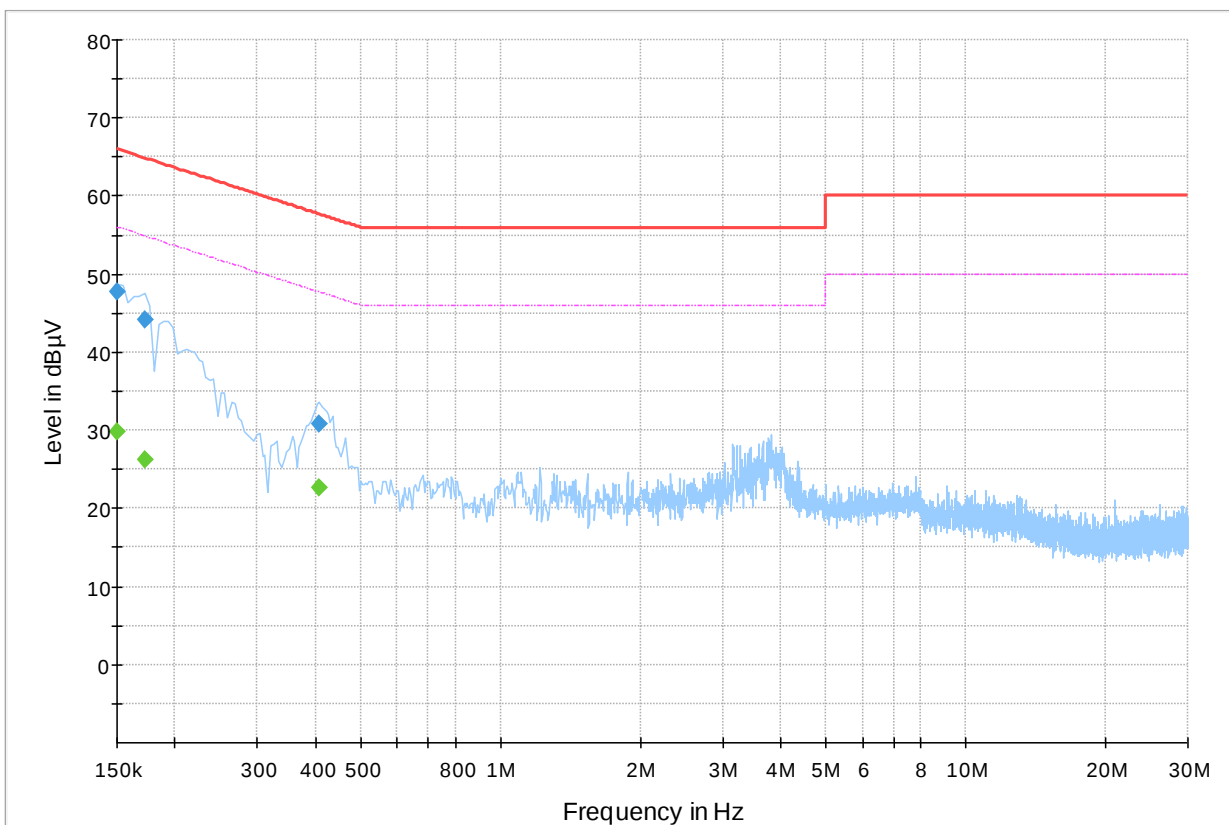
8.2.5 Measurement Plots:

Plot # 1

Disclaimer: Any measurement data within 2dB from the limit line is conditional PASS/FAIL due to measurement uncertainty considerations.

Final_Result

Frequency (MHz)	QuasiPeak (dBμV)	CAverage (dBμV)	Limit (dBμV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)	Comment
0.150	---	29.91	56.00	26.09	500.0	9.000	L1	GND	10.3	
0.150	47.71	---	66.00	18.29	500.0	9.000	L1	GND	10.3	
0.172	---	26.26	54.87	28.60	500.0	9.000	L1	GND	10.6	
0.172	44.26	---	64.87	20.61	500.0	9.000	L1	GND	10.6	
0.409	---	22.70	47.67	24.96	500.0	9.000	N	GND	10.0	
0.409	30.75	---	57.67	26.92	500.0	9.000	N	GND	10.0	



◆ Preview Result 1-PK+ Final_Result QPK
 ◆ EN 55032 Voltage on Mains QP Final_Result CAV
 ◆ EN 55032 Voltage on Mains AV

9 Test setup photos

Setup photos are included in supporting file name: "EMC_MEIGR-011-21001_Setup_Photos.pdf"

10 Test Equipment and Ancillaries Used For Testing

Equipment Type	Manufacturer	Model	Serial #	Calibration Cycle	Last Calibration Date
ACTIVE LOOP ANTENNA	ETS LINDGREN	6507	00161344	3 YEARS	10/30/2020
BILOG ANTENNA	ETS.LINDGREN	3142E	00166067	3 YEARS	03/12/2020
HORN ANTENNA	EMCO	3115	00035114	3 YEARS	08/10/2020
HORN ANTENNA	ETS.LINDGREN	3117	00215984	3 YEARS	01/31/2021
HORN ANTENNA	ETS.LINDGREN	3116	00070497	3 YEARS	11/23/2020
SPECTRUM ANALYZER	R&S	FSU26	200065	3 YEARS	07/16/2019
SIGNAL ANALYZER	R&S	FSV 40	101022	3 YEARS	07/15/2019
TEST RECEIVER	R&S	ESU.EMI	100256	3 YEARS	07/16/2019
COMPACT DIGITAL BAROMETER	CONTROL COMPANY	10510-922	200236891	3 YEARS	04/13/2020
DIGITAL THERMOMETER	CONTROL COMPANY	36934-164	181230565	3 YEARS	01/10/2019
LINE IMPEDANCE STABILIZATION NETWORK	FCC	FCC-LISN-50-25-2-08	08014	3 YEARS	07/19/2019

Note: Equipment used meets the measurement uncertainty requirements as required per applicable standards for 95% confidence levels. Calibration due dates, unless defined specifically, falls on the last day of the month. Items indicated "N/A" for cal status either do not specifically require calibration or is internally characterized before use.

11 Revision History

Date	Report Name	Changes to report	Report prepared by
2021-04-23	EMC_MEIGR_011_21001_15.247_BT_DTS	Initial version	Yuchan Lu

<<The End>>