



FCC / IC Spot Check

Test Report

FOR:

Square, Inc.

Model Name:

S8-x

Product Description:

Wireless card reader accepting NFC contactless payments and EMV chip card transactions.

FCC ID: 2AF3K-SHR1

IC ID: 21827-JBR1

Applied Rules and Standards:

47 CFR Part 15.247 (DTS)

RSS-247 Issue 1 (DTSs) & RSS-Gen Issue 4

REPORT #: EMC_GARMIN_047_17001_15.247_BT_DTS_SPOT CHECK

DATE: 12/13/2017



A2LA Accredited

IC recognized #
3462B-2

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1 Assessment

The following device was evaluated with spot check testing against the applicable criteria specified in FCC rules Parts 15.247 of Title 47 of the Code of Federal Regulations and the relevant ISED Canada standard RSS-247.

No deviations were ascertained.

Company	Description	Model #
Square, Inc.	Wireless card reader accepting NFC contactless payments and EMV chip card transactions.	S8-x

Responsible for Testing Laboratory:

12/13/2017	Compliance	James Donnellan (Lab Manager)	
Date	Section	Name	Signature

Responsible for the Report:

12/13/2017	Compliance	Elijah Garcia (EMC 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
Lab Manager:	James Donnellan
Responsible Project Leader:	Elijah Garcia

2.2 Identification of the Client

Applicant's Name:	Square, Inc.
Street Address:	1455 Market Street, Suite 600
City/Zip Code:	San Francisco, CA 94103Cary, NC 27518
Country:	USA

2.3 Identification of the Manufacturer

Manufacturer's Name:	Foxlink Precision Industry Co., Ltd.
Manufacturers Address:	Electronics Co., Ltd. Junda Industry DistrictNo. 68, Jangshu 2nd Road
City/Zip Code:	Dong-Keng, Dong-Guan, Guang-Dong
Country:	China

3 Equipment Under Test (EUT)

3.1 EUT Specifications

Model No:	S8-x
HW Version :	A-PRD-0103
SW Version :	Ver.205016
FCC-ID :	2AF3K-SHR1
IC-ID:	21827-JBR1
Product Description:	Wireless card reader accepting NFC contactless transactions and EMV chip card transactions.
Frequency Range / number of channels:	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 4.1 Low Energy (BT LE)
Modes of Operation:	BT LE
Antenna Information as declared:	Internal antenna: max gain (2.4 GHz) = 0.9 dBi
Max. Peak Output Power:	Conducted Average Power 1.4 dBm
Power Supply/ Rated Operating Voltage Range:	3.2 V dc (min) / 3.7 V dc (nom) / 5 V dc (max)
Operating Temperature Range:	0 °C to 40 °C
Other Radios included in the device:	13.56 MHz NFC
Sample Revision:	<input type="checkbox"/> Prototype Unit; <input checked="" type="checkbox"/> Production Unit; <input type="checkbox"/> Pre-Production

3.2 EUT Sample details

EUT #	Serial Number	HW Version	SW Version	Notes/Comments
1	550LS07009016827	A-PRD-0103	Ver.205016	Spot check testing

3.3 Accessory Equipment (AE) details

AE #	Type	Model	Manufacturer	Serial Number
-	-	-	-	-

3.1 Ancillary Equipment (AE) details

AE #	Type	Model	Manufacturer	Serial Number
1	Laptop	A1369	Apple	C02HQ2Q1DJWT

3.2 Test Sample Configuration

EUT Set-up #	Combination of AE used for test set up	Comments
1	EUT#1 + AE#1	-

3.3 Justification for Worst Case Mode of Operation

During the testing process, the EUT was tested with transmitter set on middle channel, and 100% duty cycle. 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 by utilizing spot check testing according to the relevant requirements specified in FCC rules Part 15.247 of Title 47 of the Code of Federal Regulations and Radio Standard Specification RSS-247 of ISED Canada.

This spot check test report is a C2PC under the FCC ID: 2AF3K-SHR1, IC ID: 21827-JBR1

Testing procedures are based on 558074 D01 DTS Meas Guidance v04 – “GUIDANCE FOR PERFORMING COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEMS (DTS) OPERATING UNDER SECTION 15.247” - April 5, 2017, 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) RSS-247 5.2(1)	Emission Bandwidth	Nominal	BTLE	<input type="checkbox"/>	<input type="checkbox"/>	■	See note 1
§15.247(e) RSS-247 5.2(2)	Power Spectral Density	Nominal	BTLE	<input type="checkbox"/>	<input type="checkbox"/>	■	See note 1
§15.247(b)(1) RSS-247 5.4(4)	Maximum Conducted Output Power and EIRP	Nominal	BTLE	<input type="checkbox"/>	<input type="checkbox"/>	■	See note 1
§15.247(d) RSS-247 5.5	Band edge compliance Unrestricted Band Edges	Nominal	BTLE	<input type="checkbox"/>	<input type="checkbox"/>	■	See note 1
§15.247; 15.209; 15.205 RSS-Gen 8.9; 8.10	Band edge compliance Restricted Band Edges	Nominal	BTLE	<input type="checkbox"/>	<input type="checkbox"/>	■	See note 1
§15.247(d); §15.209 RSS-Gen 6.13	TX Spurious emissions-Radiated	Nominal	BTLE	■	<input type="checkbox"/>	<input type="checkbox"/>	Complies
§15.207(a) RSS Gen 8.8	AC Conducted Emissions	Nominal	BTLE	<input type="checkbox"/>	■	<input type="checkbox"/>	N/A

Note 1: Leveraged from previous report (EMC_SQUAR-023-16001_15.247_BT_LE_rev2)

NA= Not Applicable; NP= Not Performed.

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 Date of Testing:

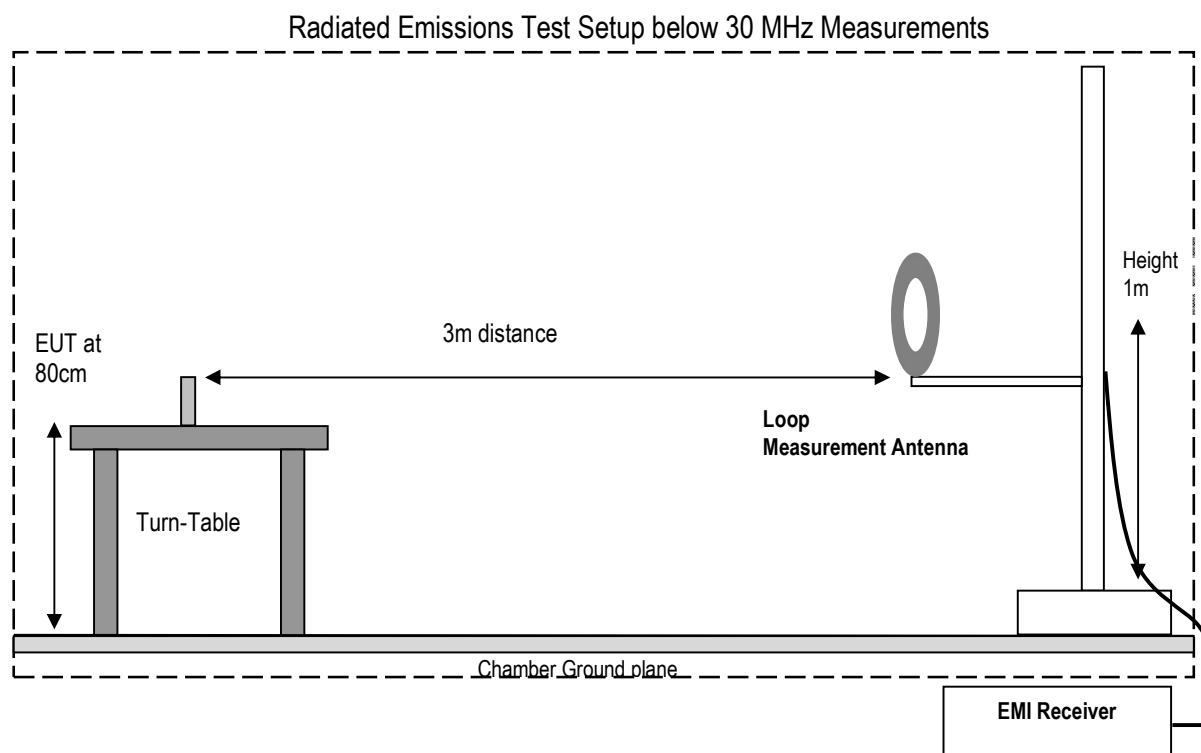
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7 Measurement Procedures

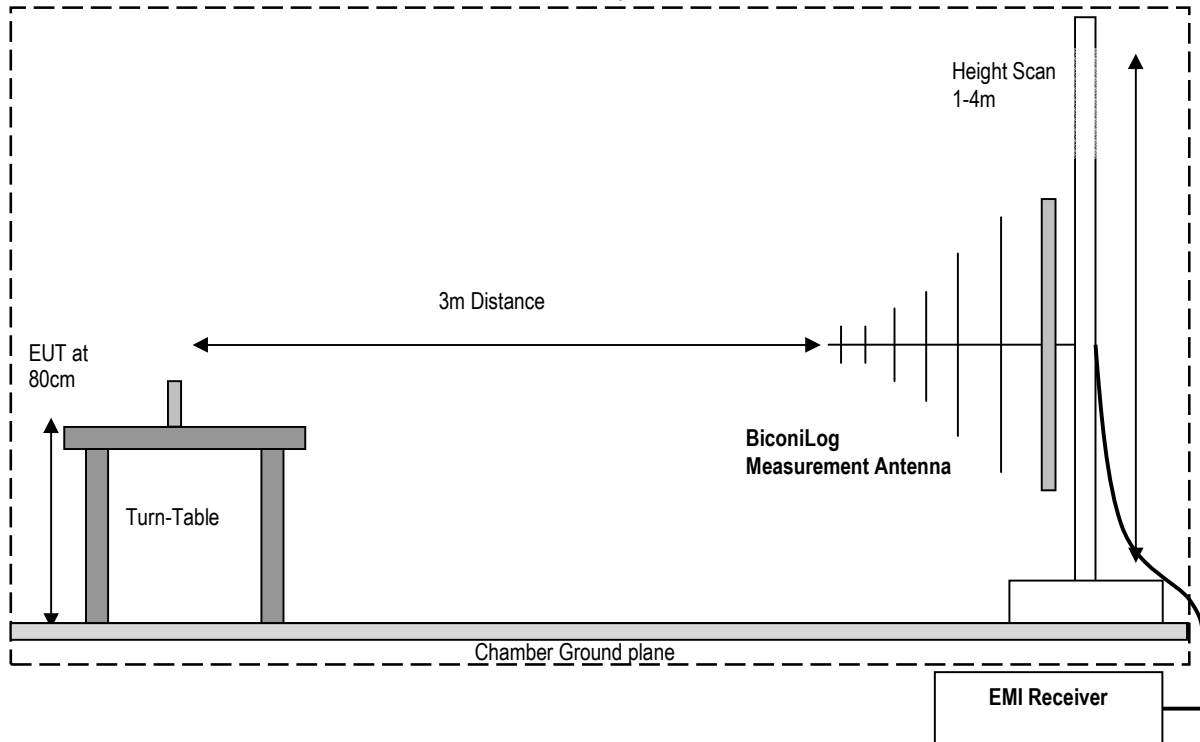
7.1 Radiated Measurement

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

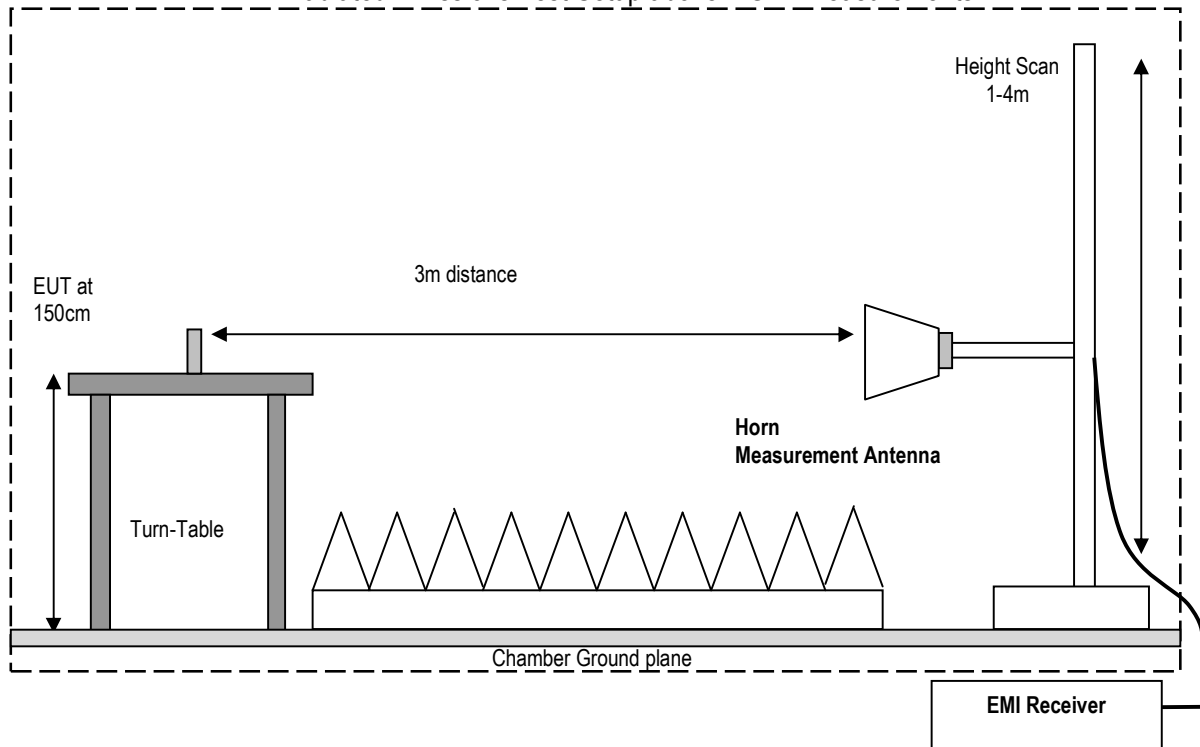
- The exploratory measurement is accomplished by running a matrix of 16 sweeps over the required frequency range with R&S Test-SW EMC32 for 4 positions of the turntable, two orthogonal positions of the EUT and both antenna polarizations. This procedure exceeds the requirement of the above standards to 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 30 MHz-1 GHz Measurements



Radiated Emissions Test Setup above 1 GHz 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 Spectrum Analyzer 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

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 (<1 GHz)

- 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 & RSS-Gen 8.9

- 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 & RSS-Gen 8.10

- 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

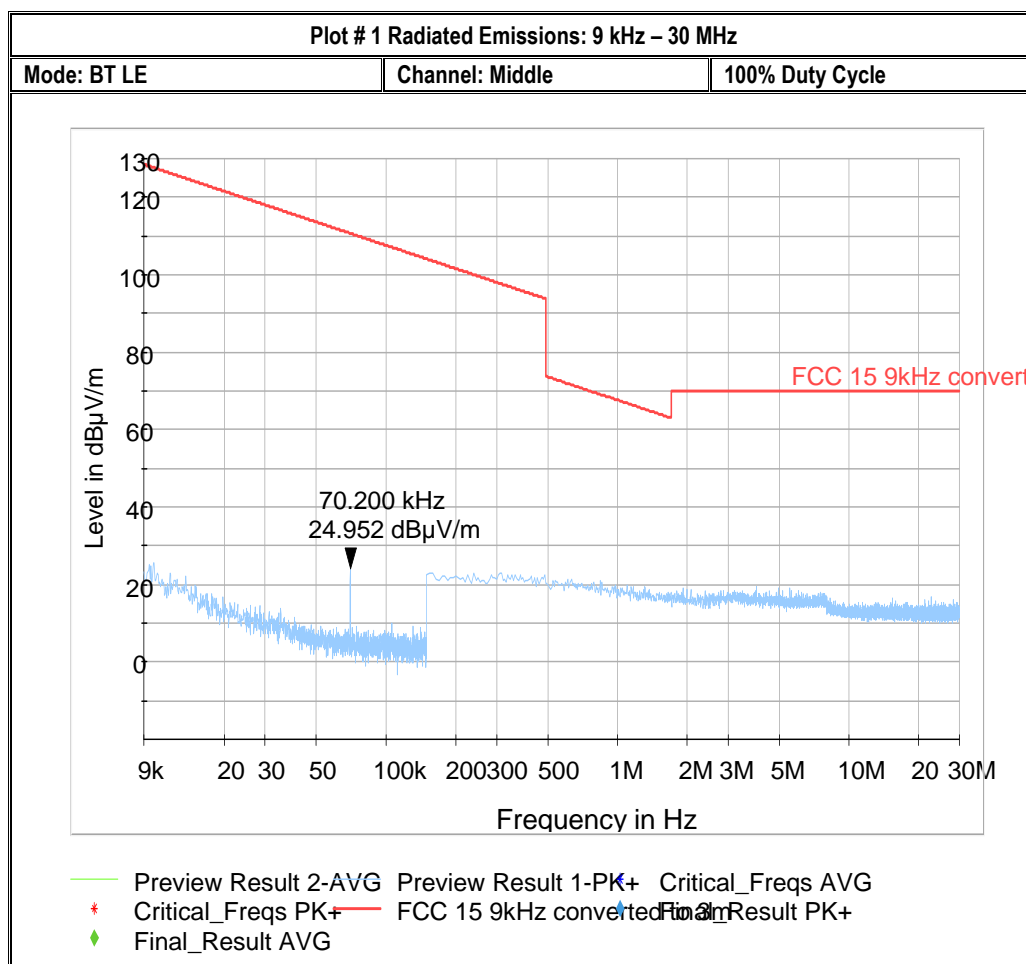
8.1.3 Test conditions and setup:

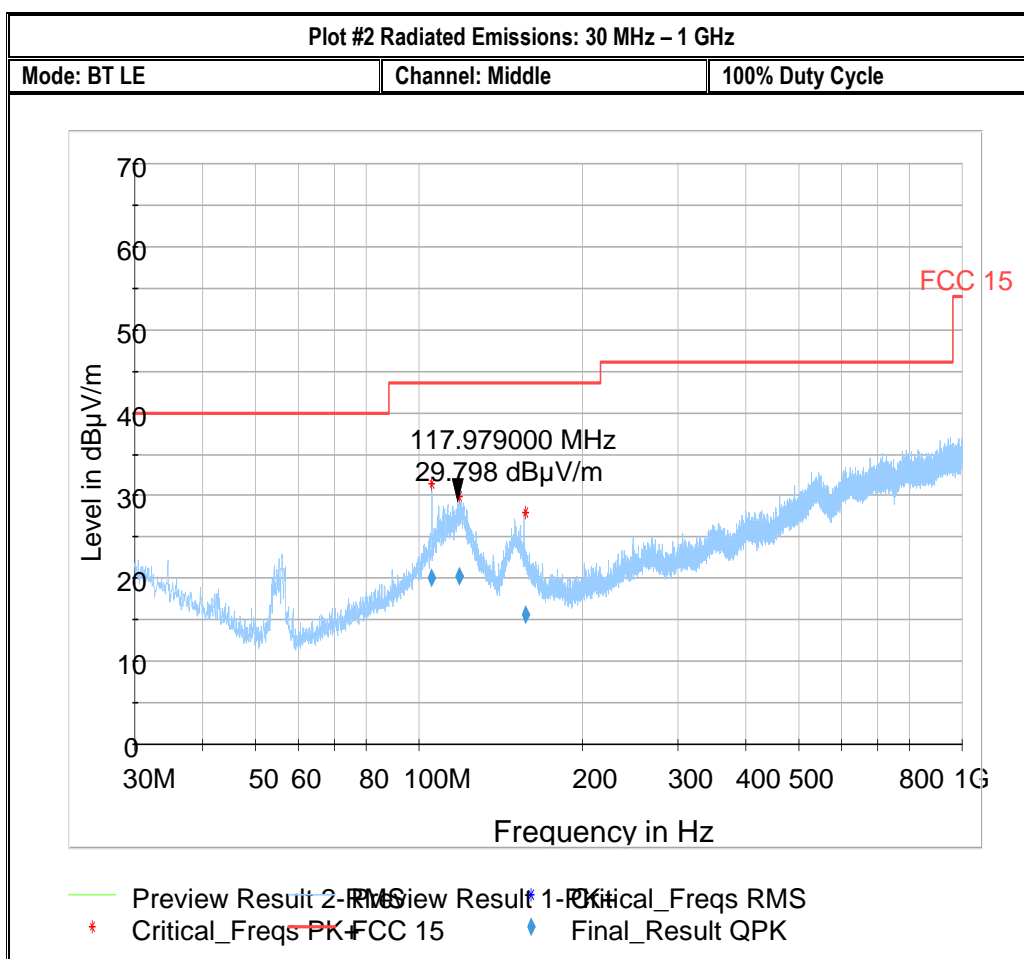
Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
23° C	1	BT LE	5 VDC

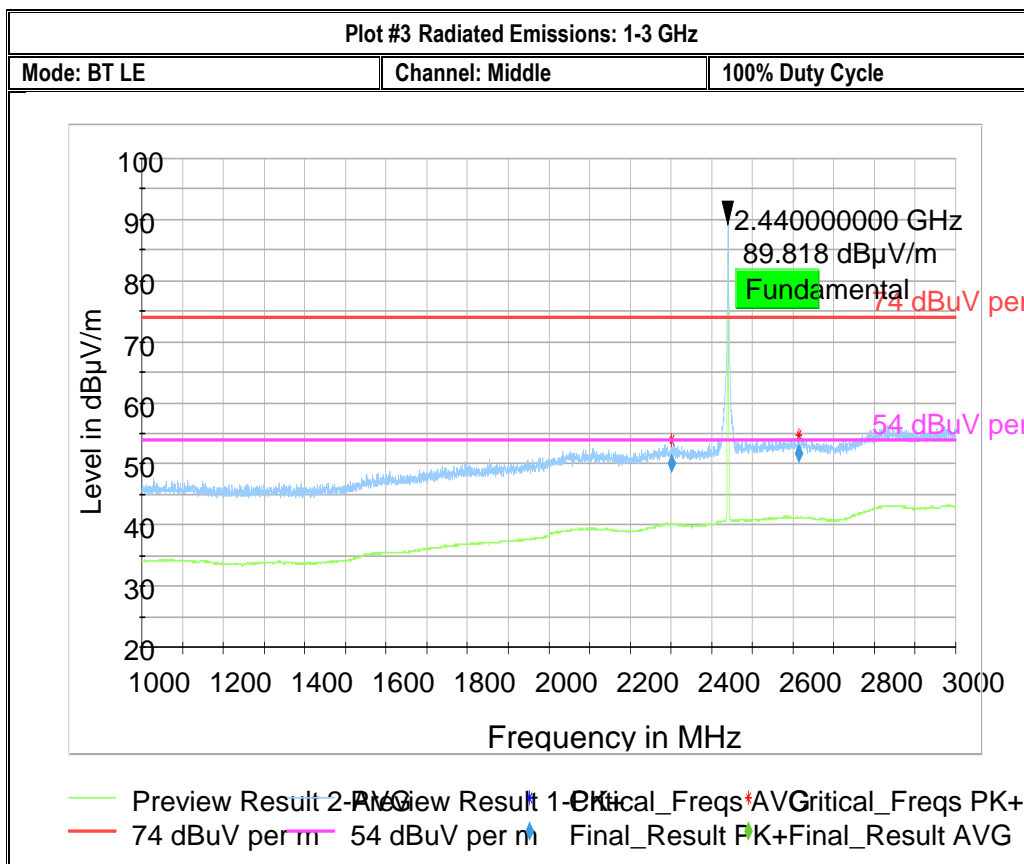
8.1.4 Measurement result:

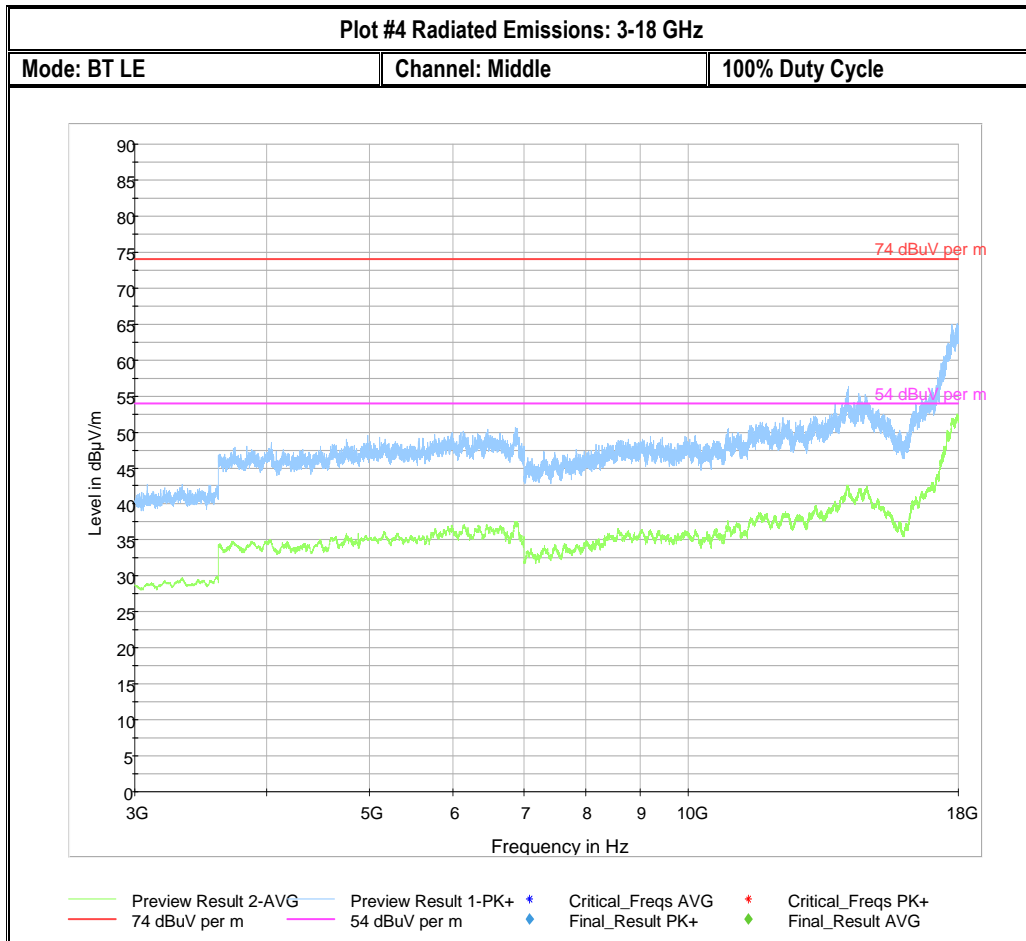
Plot #	Channel #	Scan Frequency	Limit	Result
1-5	Middle	9 kHz – 26 GHz	See section 8.1.2	Pass

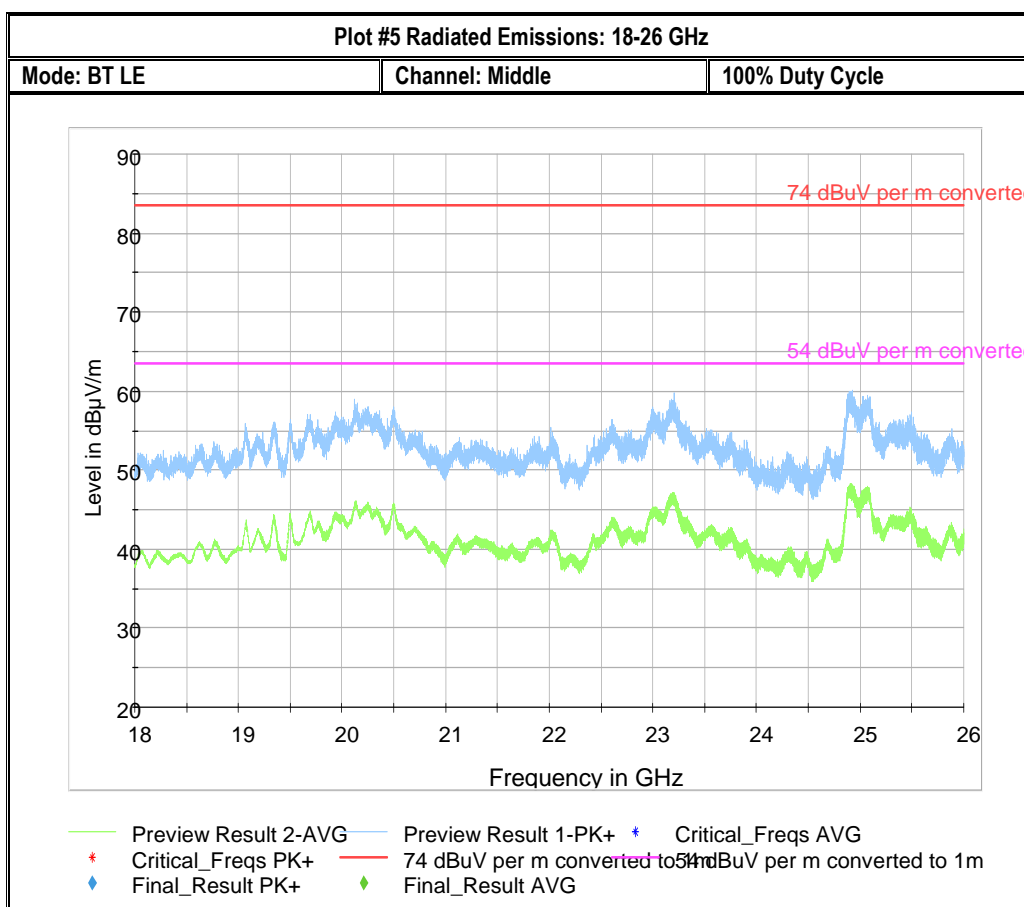
8.1.5 Measurement Plots:











9 Test setup photos

Setup photos are included in supporting file name: "EMC_SQUAR-040-17001_15.247_BT_DTS_SPOT CHECK_Setup_Photos.pdf"

10 Test Equipment And Ancillaries Used For Testing

Equipment Type	Manufacturer	Model	Serial #	Calibration Cycle	Last Calibration Date
BiconiLog Antenna	EMCO	3142E	166067	3 years	June 2017
Turn table	EMCO	2075	N/A	N/A	N/A
MAPS Position Controller	ETS Lindgren	2092	0004-1510	N/A	N/A
Antenna Mast	EMCO	2075	N/A	N/A	N/A
Relay Switch Unit	Rohde & Schwarz	RSU	338964/001	N/A	N/A
Loop Antenna	ETS Lindgren	6512	00049838	3 years	July 2017
Horn Antenna	EMCO	3115	35111	3 years	July 2015
Compact Digital Barometer	Control Company	35519-055	91119547	2 years	June 2017
Spectrum Analyzer	R&S	FSU	200256	2 years	July 2017
Horn Antenna	ETS Lindgren	3116	00070497	3 years	October 2017
High Pass Filter	WainWright	WHK3.0/18G-10SS	210	Part of system calibration	
Pre-Amplifier	Miteq	J54-00102600	00616	Part of system calibration	

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
2017-12-13	EMC_SQUAR_040_17001_15.247_BT_DTS_SPOT CHECK	Initial Report	Elijah Garcia