



Canada

EMC & RF Test Report

As per

RSS-247 Issue 2:2017 & FCC Part 15 Subpart 15.247:2017

Unlicensed Intentional Radiators

on the

SPC1 Wireless card reader

Issued by:

TÜV SÜD Canada Inc.
11 Gordon Collins Dr,
Gormley, ON, L0H 1G0
Canada
Ph: (905) 883-7255

Prepared by:

Raymond Lee Au,
Project Engineer

Reviewed by:

Amir Emami,
Project Engineer

Testing produced for



See Appendix A for full client &
EUT details.



Testing Laboratory
Certificate #2955.02



R-4023, G-506
C-4498, T-1246



Registration #
CA6844



Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Table of Contents

Table of Contents	2
Report Scope	3
Summary	4
Test Results Summary	5
Notes, Justifications, or Deviations	6
Sample Calculation(s)	7
Applicable Standards, Specifications and Methods	8
Document Revision Status	9
Definitions and Acronyms	10
Testing Facility	11
Calibrations and Accreditations	11
Testing Environmental Conditions and Dates	12
Detailed Test Results Section	13
Maximum Peak Conducted Power	14
Maximum Peak E.I.R.P Output	19
Transmitter Spurious Radiated Emissions	28
Appendix A – EUT Summary	54
Appendix B – EUT and Test Setup Photos	56

Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Report Scope

This report addresses the EMC verification testing and test results of the wireless card reader accepting NFC contactless payments and EMV chip card transactions unit from Square Inc, model: **SPC1**. This unit is herein referred to as EUT (Equipment Under Test).


The EUT was tested for compliance following a Class II Permissive Change (C2PC) per FCC part 2.1043, against the following standard:

FCC Part 15 Subpart C 15.247:2017

Test procedures, results, justifications, and engineering considerations, if any, follow later in this report.

This report does not imply product endorsement by any government, accreditation agency, or TÜV SÜD Canada Inc.

Opinions or interpretations expressed in this report, if any, are outside the scope of TÜV SÜD Canada Inc. accreditations. Any opinions expressed do not necessarily reflect the opinions of TÜV SÜD Canada Inc., unless otherwise stated.

Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Summary

The results contained in this report relate only to the item(s) tested.

EUT Model:	SPC1
FCC Certification #, FCC ID:	2AF3K-SPC1
EUT passed all tests performed	Yes
Tests conducted by	Raymond Lee Au

For testing dates, see "Testing Environmental Conditions and Dates".

Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Test Results Summary

Standard/Method	Description	Class/Limit	Result
FCC 15.203	Antenna Requirement	Unique	Pass ^α
FCC 15.209 RSS-GEN (Tables 5 & 6)	Spurious Radiated Emissions & Band Edges	QuasiPeak Average	Pass
FCC 15.247(b)(3) RSS-247 5.4(d)	Max Output Power	≤ 1 Watt (≤ 30 dBm)	Pass
RSS-247 5.4(d)	Max E.I.R.P Output	≤ 4 Watt (≤ 36 dBm)	Pass
FCC 15.247(b)(4) RSS-247 5.4(d)	Antenna Gain	≤ 6 dBi	Pass ^α
FCC 15.247(i) RSS-102 (Table 1)	Maximum RF exposure	≤ 5 mm SAR exemption	Pass ^β
Overall Result			Pass

^α See *Notes, Justifications, or Deviations* section for more details.

^β See RF Exposure exhibit (separate from this report) for more details.

If the product as tested or otherwise complies with the specification, the EUT is deemed to comply with the requirement and is deemed a 'PASS' grade. If not 'FAIL' grade will be issued. Note that 'PASS' / 'FAIL' grade is independent of any measurement uncertainties.

Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Notes, Justifications, or Deviations

The following notes, justifications for tests not performed or deviations from the above listed specifications apply:

This report incorporates test results performed following a change to the EUT by the manufacturer. The source of the 32 kHz clock used on the BLE controller IC is changed from using the internal oscillator to an external crystal. The frequency remains at 32 kHz. This clock is used by the on-chip processor to handle standby modes. There are no other changes to the EUT, and the clock used to generate the BLE radio frequencies is not changed.

The EUT is a portable credit card reader with BLE (2.402 – 2.480 MHz) and NFC RFID (13.56 MHz) capabilities. This report deals with the BLE characteristics (tested to FCC 15.247). See report # 7169005271R-NFC-000 for the report regarding the RFID characteristics (tested to FCC 15.225).

For the antenna requirement specified in FCC 15.203, the BLE antenna used is an Inverted F antenna soldered onto the PCB, which will be sealed within the unit's enclosure. It is not meant to be replicable by the user.

All testing is performed with the RFID also activated and constantly transmitting modulated data at its maximum power.

For the Restricted Bands of operation, the BLE is designed to only operate between 2400 – 2483.5 MHz.


The EUT is not a hybrid system.

The EUT was tested positioned in the three orthogonal axis. Worst case results are presented, and occurs with the EUT positioned flat during BLE testing. See *Appendix B* for test photos.

The EUT's output is set to transmit continuously at 100% duty cycle at the maximum output power.

The antenna gain for the 15.247 transmitter is 0.9 dBi

The EUT operates using an internal battery rechargeable by a USB port. It does not have the means to plug into mains directly. Tests were performed with the battery fully charged.

Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

SAR assessment is applied to the EUT. An assessment distance of ≤ 5 mm is applied. The device meets the SAR Test exemption criteria and no test is required. See RF Exposure exhibits for more details.

Sample Calculation(s)

Radiated Emission Test

Margin = Limit – (Received Signal + Antenna Factor + Cable Loss – Pre-Amp Gain)

Margin = 50.5dB μ V/m – (50dB μ V + 10dB + 2.5dB – 20dB)


Margin = 8.0 dB (pass)

Power Line Conducted Emission Test

Margin = Limit – (Received Signal + Attenuation Factor + Cable Loss + LISN Factor)


Margin = 73.0dB μ V – (50dB μ V + 10dB + 2.5dB + 0.5dB)

Margin = 10.0 dB (pass)

Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	


Applicable Standards, Specifications and Methods

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 For Testing Unlicensed Wireless Devices
CFR 47 FCC 15 Subpart C:2017	Code of Federal Regulations – Radio Frequency Devices, Intentional Radiators
FCC KDB 558074: 2017	FCC KDB 558074 Digital Transmission Systems, measurements and procedures
FCC KDB 447498: 2015	RF exposure procedures and equipment authorization policies for mobile and portable devices
RSS-Gen Issue 5 2018	General Requirements and Information for the Certification of Radio Apparatus
RSS-102 Issue 5:2015	Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)
RSS-247 Issue 2:2017	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
ISO 17025:2005	General Requirements for the Competence of Testing and Calibration Laboratories

Client	Square Inc.	 Canada
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Document Revision Status

Revision 000 March 7, 2019
- Initial Release

Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Definitions and Acronyms

The following definitions and acronyms are applicable in this report.
See also ANSI C63.14.

DTS – Digital Transmission System

LISN – Line Impedance Stabilization Network

NCR – No Calibration Required

NSA – Normalized Site Attenuation

N/A – Not Applicable

RF – Radio Frequency

AE – Auxiliary Equipment. A digital accessory that feeds data into or receives data from another device (host) that in turn, controls its operation.

Antenna Port – Port, other than a broadcast receiver tuner port, for connection of an antenna used for intentional transmission and/or reception of radiated RF energy.


BW – Bandwidth. Unless otherwise stated, this refers to the 6 dB bandwidth.

EMC – Electro-Magnetic Compatibility. The ability of an equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment.

EMI – Electro-Magnetic Immunity. The ability to maintain a specified performance when the equipment is subjected to disturbance (unwanted) signals of specified levels.

EUT – Equipment Under Test. A device or system being evaluated for compliance that is representative of a product to be marketed.

ITE – Information Technology Equipment. Has a primary function of entry, storage, display, retrieval, transmission, processing, switching, or control of data and/or telecommunication messages and which may be equipped with one or more ports typically for information transfer.

Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Testing Facility

Testing for EMC on the EUT was carried out at TÜV SÜD Canada labs near Toronto, Ontario. The testing lab consists of a 3m semi-anechoic chamber calibrated to be able to allow measurements on a EUT that has a maximum width or length of up to 2m and a height of up to 3m. The chamber is equipped with a turntable that is capable of testing devices up to 3300lb in weight. This facility is capable of testing products that are rated for 120Vac and 240Vac single phase, or devices that are rated for a 208Vac 3 phase input. DC capability is also available for testing. The chamber is equipped with a mast that controls the polarization and height of the antenna. Control of the mast occurs in the control room adjoining the shielded chamber. Radiated emission measurements are performed using a BiLog antenna and a Horn antenna where applicable. Conducted emissions, unless otherwise stated, are performed using a LISN and using the Vertical Ground plane if applicable.

Calibrations and Accreditations


The 3m semi-anechoic chamber is registered with Federal Communications Commission (FCC, CA6844), Industry Canada (IC, 6844A-3) and Voluntary Control Council for Interference (VCCI, R-4023, G-506, C-4498, and T-1246). This chamber was calibrated for Normalized Site Attenuation (NSA) using test procedures outlined in ANSI C63.4 "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". The chamber is lined with ferrite tiles and absorption cones to minimize any undesired reflections. The NSA data is kept on file at TÜV SÜD Canada. For radiated susceptibility testing, a 16 point field calibration has been performed on the chamber. The field uniformity data is kept on file at TÜV SÜD Canada. TÜV SÜD Canada Inc. is accredited to ISO 17025 by A2LA with Testing Certificate #2555.01. The laboratory's current scope of accreditation listing can be found as listed on the A2LA website. All measuring equipment is calibrated on an annual or bi-annual basis as listed for each respective test.

Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	


Testing Environmental Conditions and Dates

Following environmental conditions were recorded in the facility during time of testing.

Date	Test	Initials	Temperature (°C)	Humidity (%)	Pressure (kPa)
Feb. 22, 2019	Spurious Radiated Emissions 9 kHz – 30 MHz	RA	22.0	17.7	103.0
Feb. 7, 2019	Spurious Radiated Emissions 30 MHz – 1 GHz	RA	20.4	20.0	101.8
Feb. 11, 2019	Spurious Radiated Emissions & Band Edges 1 GHz – 18 GHz	RA	20.2	19.8	102.0
Mar. 1, 2019	Spurious Radiated Emissions 18 GHz – 26 GHz	RA	22.0	15.5	102.9
Feb. 14, 2018	Max Output Power	RA	20.1	17.6	101.4
Feb. 11, 2019	Max E.I.R.P Output	RA	20.2	19.8	102.0

Client	Square Inc.	 Canada
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Detailed Test Results Section

Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Maximum Peak Conducted Power

Purpose

The purpose of this test is to ensure that the maximum power conducted to the radiating element does not exceed the limits specified. This ensures that if the end-user replaces the antenna, the maximum power does not exceed an amount which may create an excessive power level.

Limits and Method

The limits are defined in FCC Part 15.247(b)(3) and RSS-247 5.4(d).


For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands, the peak limit is 1 watt (or 30 dBm = 125.2 dBμV at 3m distance). The E.I.R.P. limit is 4 watts (or 36 dBm = 131.2 dBμV at 3m distance).

The method is given in Section 9.1.2 of FCC KDB 558074 and ANSI C63.10.

Results

The EUT passed. The EUT was set to transmit at maximum power. Low, Middle and High Channels were measured. The following table shows the peak power:

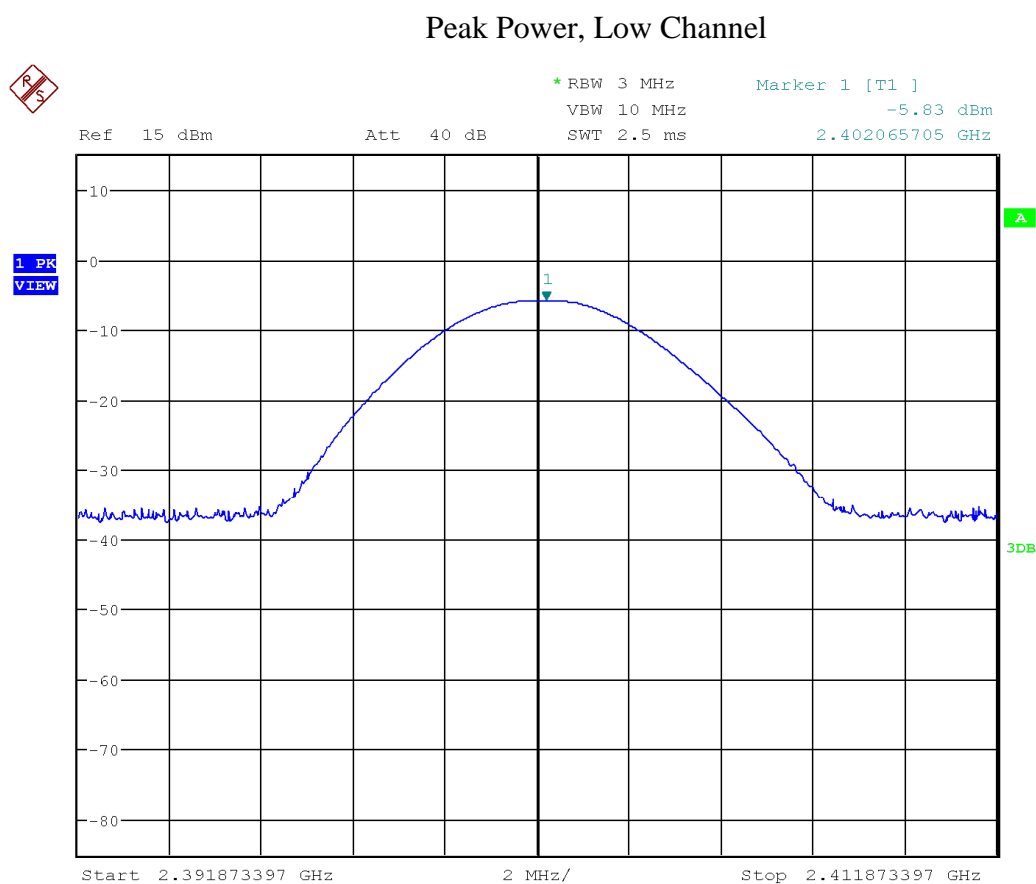
Test Frequency (MHz)	Channel	Measured Reading (dBm)	External Attenuator + Cable loss (dB)	Output Power (dBm)	Output Power (mW)	Output Limit (dBm)	Margin (dB)	Result
2402	Low	-5.83	10	4.17	2.61	30	25.83	Pass
2440	Mid	-5.84	10	4.16	2.61	30	25.84	Pass
2480	High	-6.02	10	3.98	2.50	30	26.02	Pass


Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Graphs

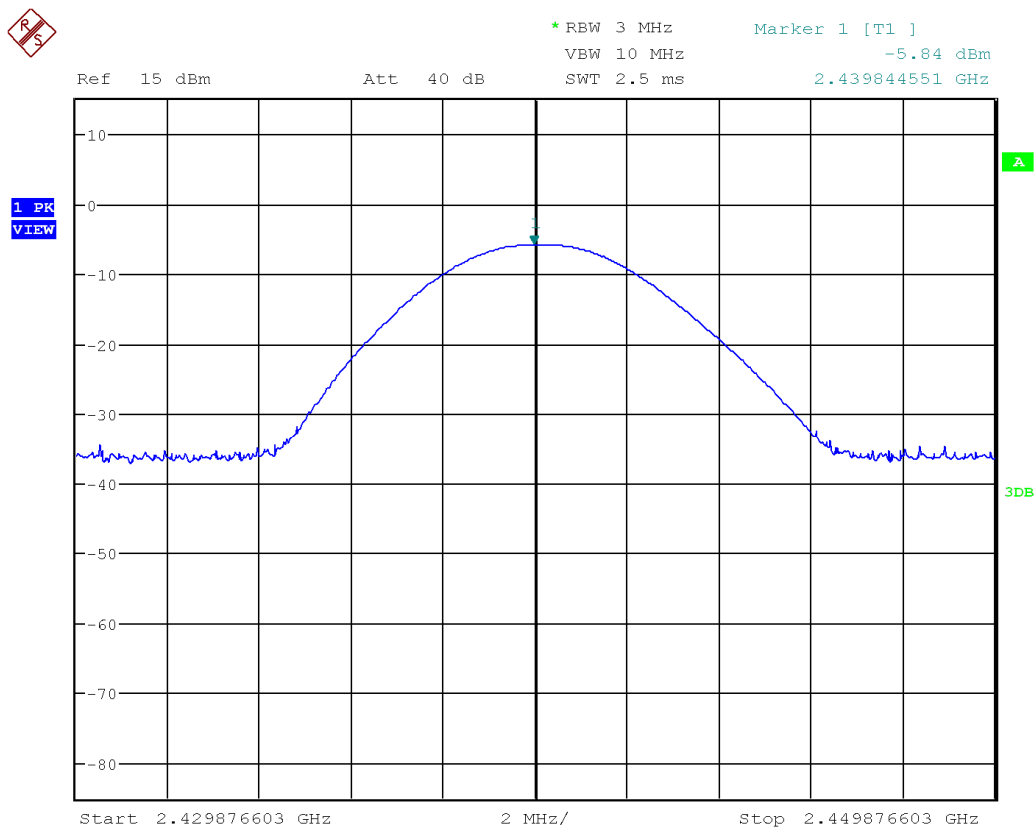
The plots shown below show the peak power output of the device during the antenna conducted measurements during transmit operation of the EUT. The measurement RBW is \geq than the DTS bandwidth.


Note: 10 dB of attenuator + cable loss applicable when making measurements shown below.



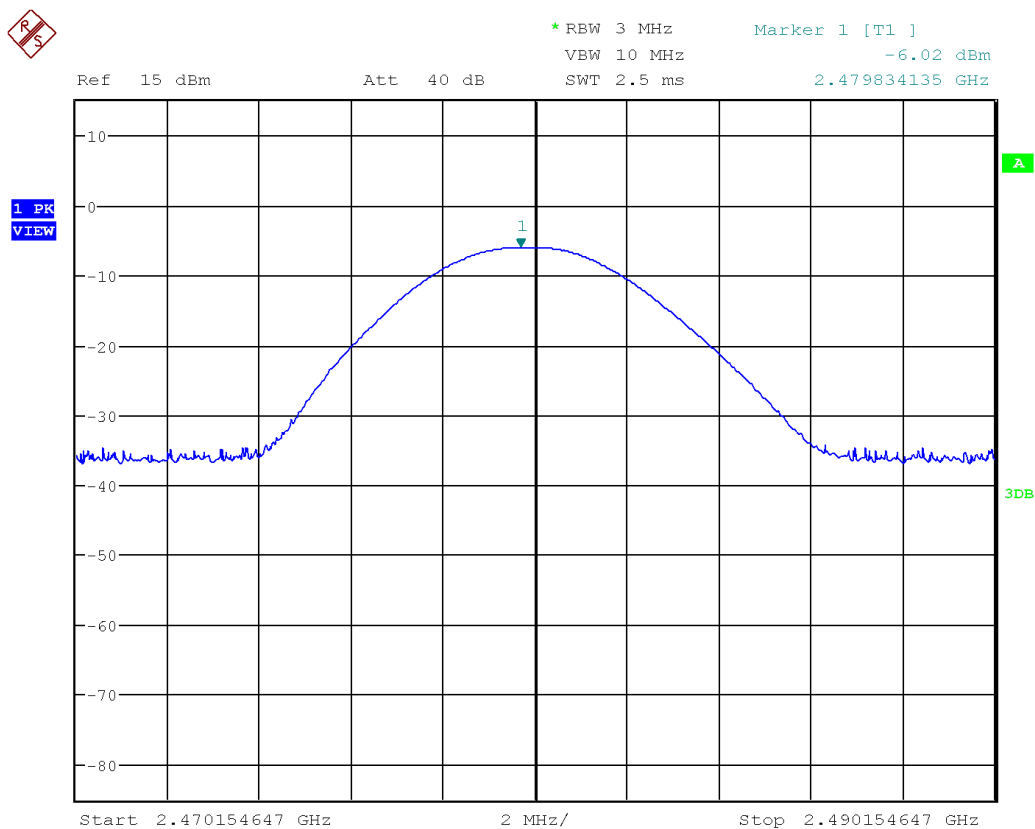
Client	Square Inc.	 Canada
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Peak Power, Mid Channel




Client	Square Inc.	 Canada
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Peak Power, High Channel




See 'Appendix B – EUT and Test Setup Photos' for photos showing the test set-up.

Client	Square Inc.	 Canada
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	FSQ 26	Rohde & Schwarz	Feb 28, 2017	Feb 28, 2019	GEMC 234

Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Maximum Peak E.I.R.P Output

Purpose

The purpose of this test is to ensure that the maximum power output does not exceed the limits specified when used with the antenna, which may provide gain. This ensures that the maximum power does not exceed an amount which may create an excessive power level.

Limits

The limits are defined in RSS-247 5.4(d).

For DTSSs operating in the 2400-2483.5 MHz band, the peak E.I.R.P. limit is 4 Watts (or 36 dBm = 131.2 dBμV at a 3m distance).

Additionally, the peak conducted output power limit is 1 Watt. The analysis of this requirement is covered in the previous section.

Results

The EUT passed. The peak E.I.R.P. is 0.92 dBm (1.24 mW, 0.00124 W, or 96.12 dBμV/m at 3 m).

Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Emission Table & Plots


The table below shows the measured peak power output of the device. Peak measurements were made during transmit operation of the EUT with continuous modulated data at the maximum output power used by the manufacturer. Worst case plots are shown.

Table 2 – Max peak E.I.R.P. output

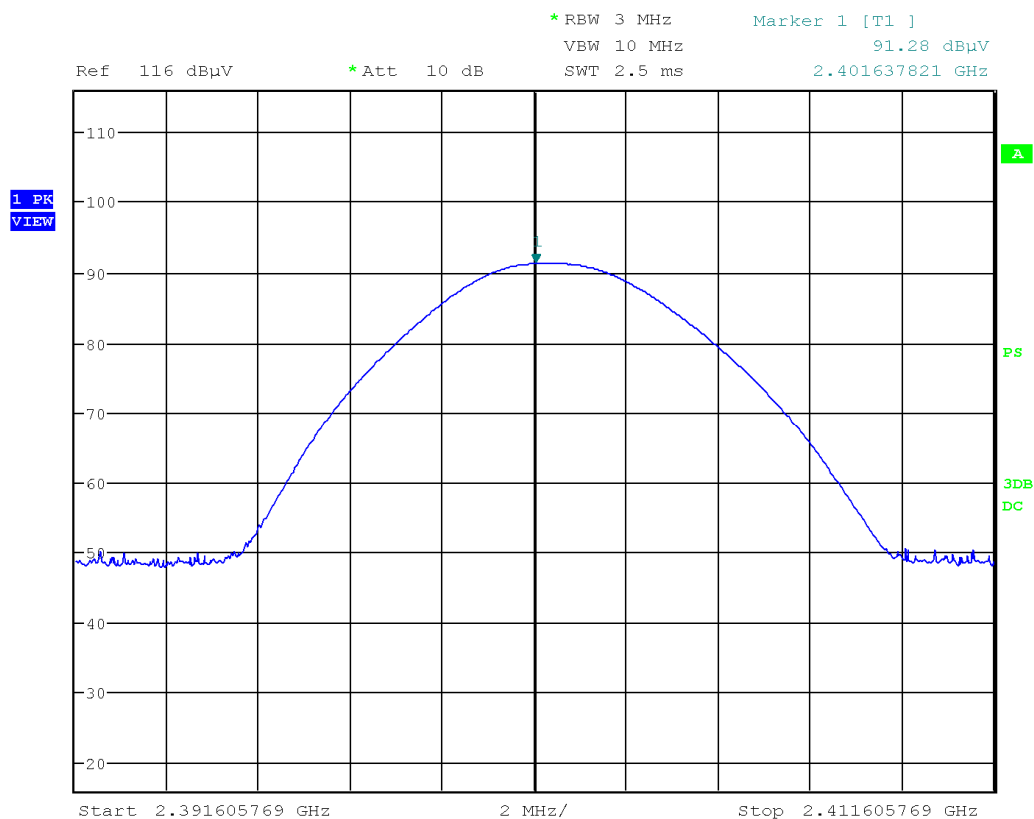
Test Frequency (MHz)	Channel	Software Channel Setting	Antenna polarity	Received Reading dB(μV)	Antenna factor (dB)	Cable Loss (dB)	Pre-Amp Gain (dB)	Received signal at 3m (dBμV)	EIRP (dBm)	Emission limit dB(μV)	Margin dB(μV)	Result
2402	Low	0	V	91.28	26.6	3.6	-34.2	87.28	-7.92	131.2	43.92	Pass
2402	Low	0	H	100.22	26.5	3.6	-34.2	96.12	0.92	131.2	35.08	Pass
2440	Middle	19	V	90.46	26.4	3.6	-34.2	86.26	-8.94	131.2	44.94	Pass
2440	Middle	19	H	99.52	26.5	3.6	-34.2	95.42	0.22	131.2	35.78	Pass
2480	High	39	V	88.99	26.3	3.6	-34.2	84.69	-10.51	131.2	46.51	Pass
2480	High	39	H	100.04	26.3	3.6	-34.2	95.74	0.54	131.2	35.46	Pass


Notes:

Antenna polarity
V = Vertical
H = Horizontal

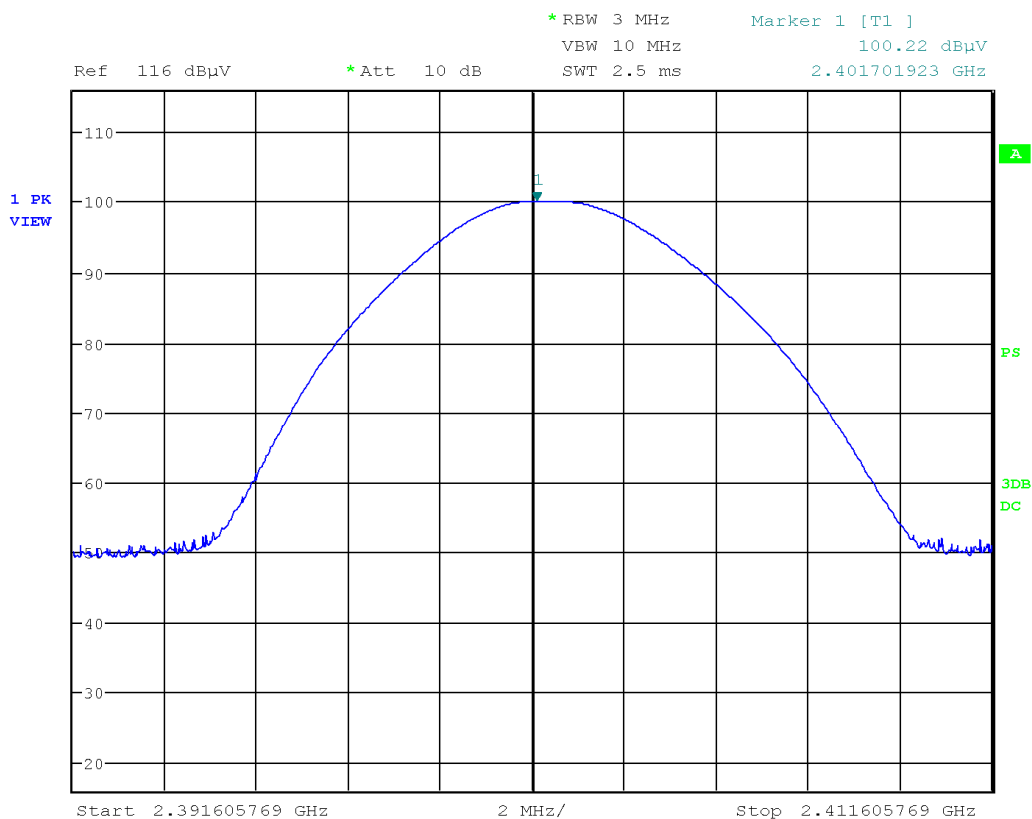
Client	Square Inc.	 Canada
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	


Low Channel Vertical Antenna Polarity



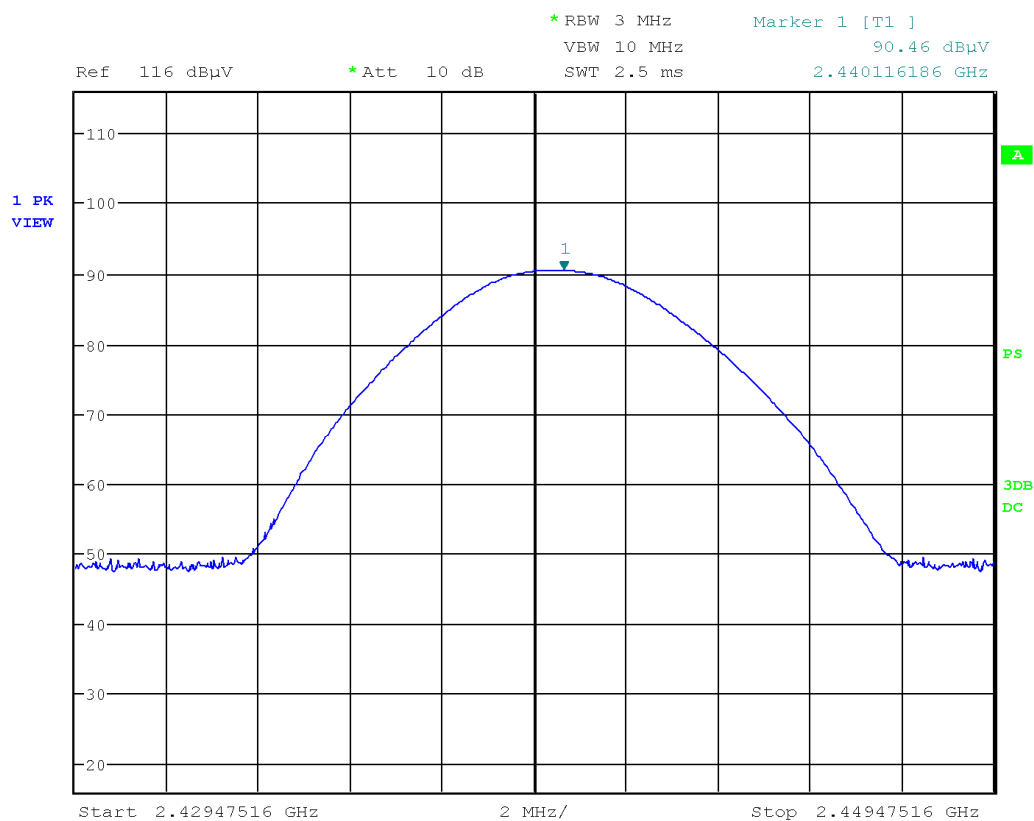
Client	Square Inc.	 Canada
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	


Low Channel Horizontal Antenna Polarity



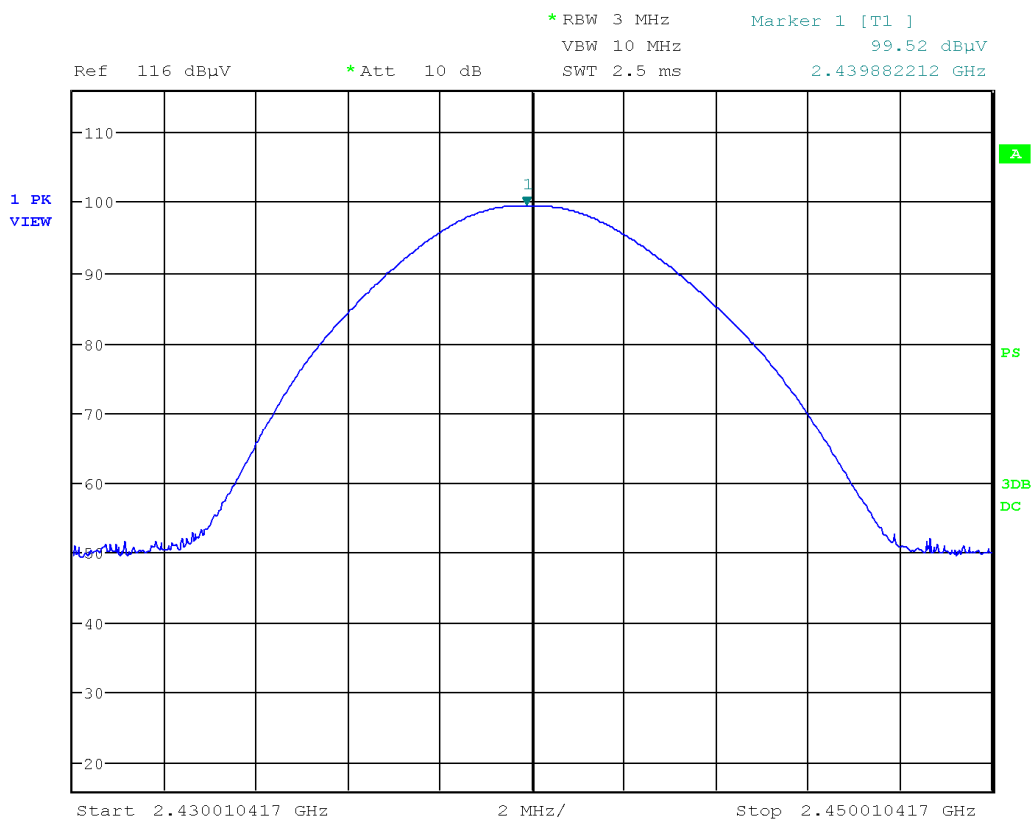
Client	Square Inc.	 Canada
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	


Middle Channel Vertical Antenna Polarity



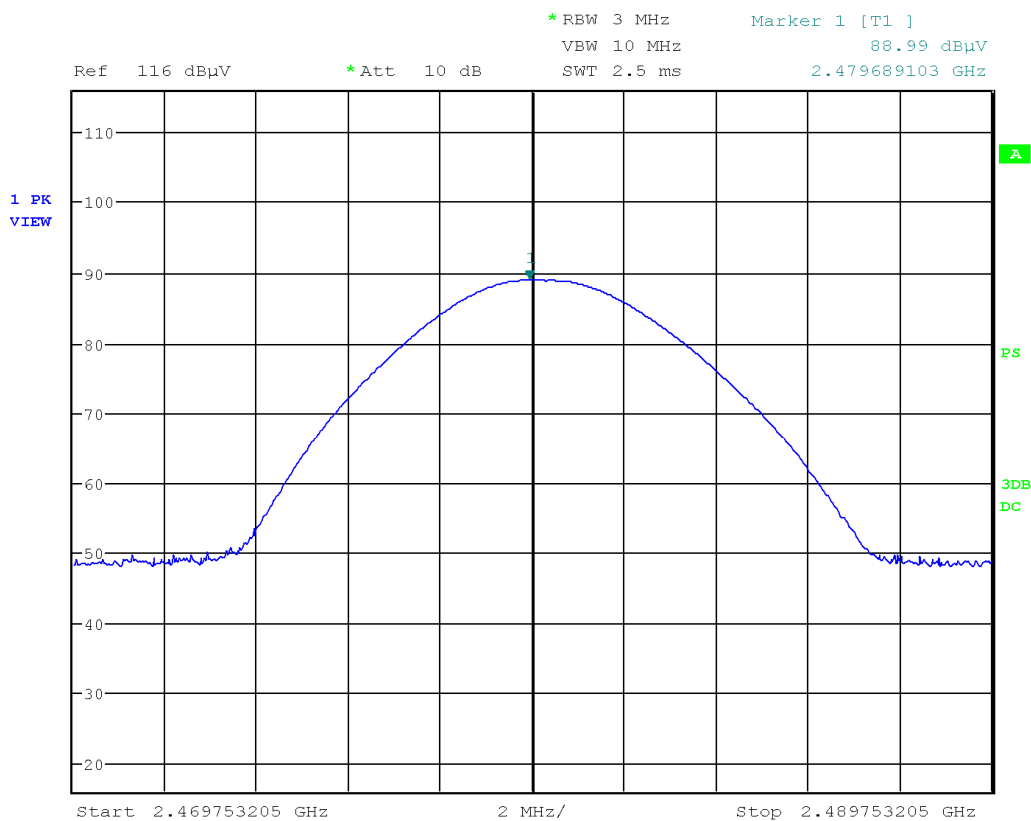
Client	Square Inc.	 Canada
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	


Middle Channel Horizontal Antenna Polarity



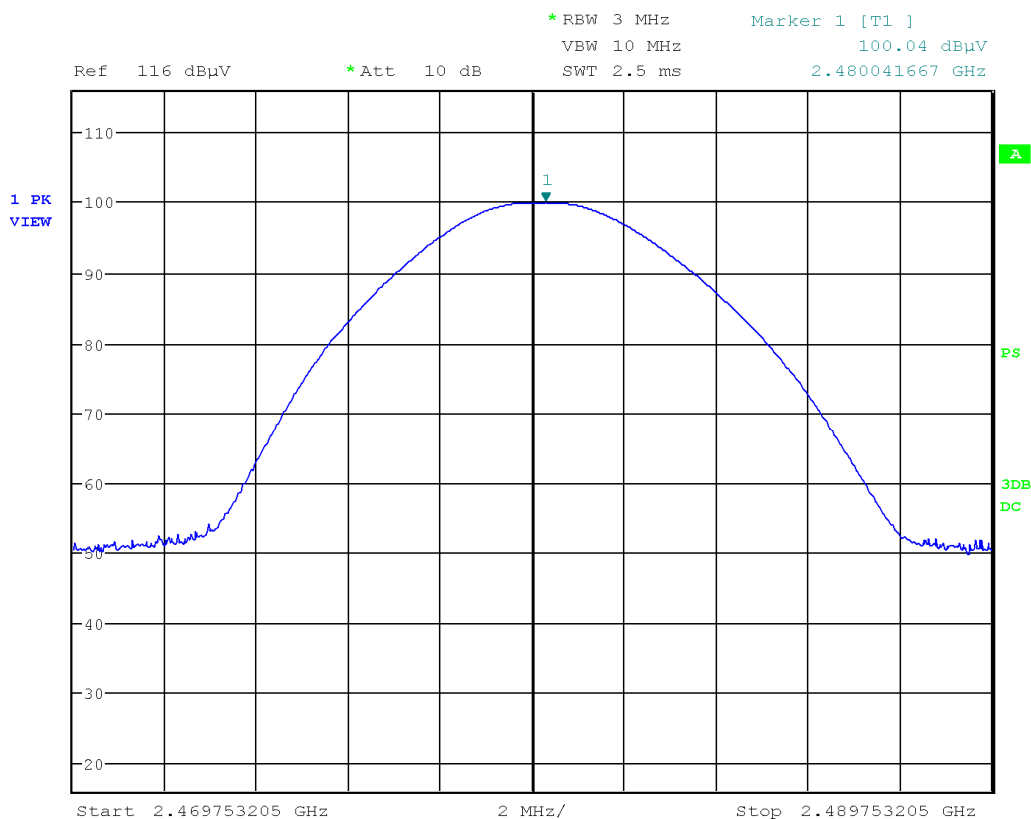
Client	Square Inc.	 Canada
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

High Channel Vertical Antenna Polarity



Client	Square Inc.	 Canada
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

High Channel Horizontal Antenna Polarity




Note: See 'Appendix B – EUT & Test Setup Photographs' for photos showing the test set-up.

Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	ESU 40	Rohde & Schwarz	Jan. 12, 2018	Jan. 12, 2020	GEMC 233
Horn Antenna	WBH218HN	Q-par	Feb. 27, 2018	Feb. 27, 2020	GEMC 6375
Pre-Amp	HP 8449B	HP	Nov. 15, 2017	Nov. 15, 2019	GEMC 189
RF Cable 10m	LMR-400-10M-50Ω-MN-MN	LexTec	NCR	NCR	GEMC 274
RF Cable 2m	Sucoflex 104A	Huber+Suhner	NCR	NCR	GEMC 271

Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Transmitter Spurious Radiated Emissions

Purpose

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT does not exceed the limits listed below as defined in the applicable test standard, as measured from a receiving antenna. This helps protect broadcast radio services such as television, FM radio, pagers, cellular telephones, emergency services, and so on, from unwanted interference.

Limits and Method

The method is defined in Section 12 of FCC KDB 558074 and ANSI C63.10.

The requirement is stated in FCC 15.247(d), and RSS-247 5.5.

The restricted bands are defined in 47 CFR FCC Part 15.205(a) and RSS-Gen (Table 7).

The limits are as defined in 47 CFR FCC Part 15.209 and RSS- Gen (Table 5 and Table 6).

The limits apply for emissions that fall within the restricted bands.

The limits for unintentional radiated emissions apply for those emissions that fall in the restricted bands. These limits are as follows:

Frequency	Limit
0.009 MHz – 0.490 MHz	2400/F(kHz) uV/m at 300m ¹
0.490 MHz – 1.705 MHz	24000/F(kHz) uV/m at 30m ¹
1.705 MHz – 30 MHz	30 uV/m at 30m ¹
30 MHz – 88 MHz	100 uV/m (40.0 dBuV/m ¹) at 3m
88 MHz – 216 MHz	150 uV/m (43.5 dBuV/m ¹) at 3m
216 MHz – 960 MHz	200 uV/m (46.0 dBuV/m ¹) at 3m
Above 960 MHz	500 uV/m (54.0 dBuV/m ¹) at 3m
Above 1000 MHz	500 uV/m (54 dBuV/m ²) at 3m
Above 1000 MHz	500 uV/m (74 dBuV/m ³) at 3m

¹Limit is with Quasi Peak detector with bandwidths as defined in CISPR-16-1-1

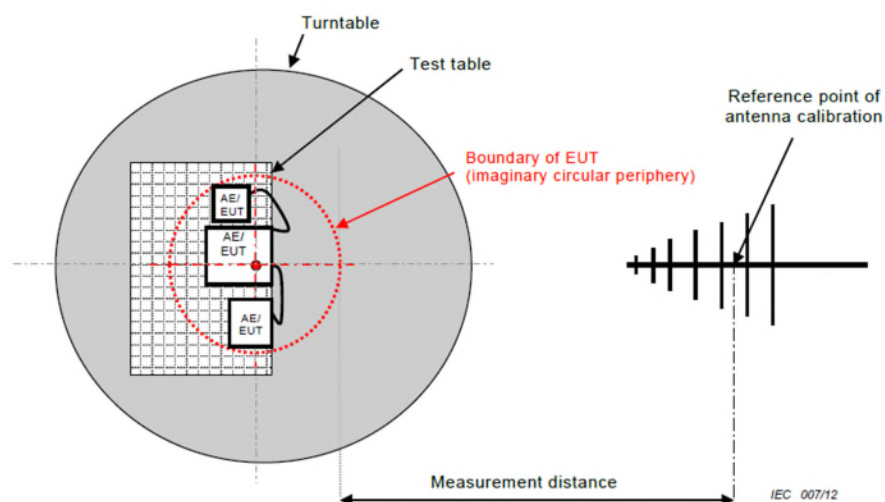
²Limit is with 1 MHz measurement bandwidth and using an Average detector

³Limit is with 1 MHz measurement bandwidth and using a Peak detector

Based on ANSI C63.4 Section 4.2, if the Peak detector measurements do not exceed the Quasi-Peak limits, where defined, then the EUT is deemed to have passed the requirements.


Client	Square Inc.	 Canada
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Typical Radiated Emissions Setup



Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is $\pm 4.25\text{dB}$ for 30MHz – 1GHz and $\pm 4.93\text{dB}$ for 1GHz – 18GHz with a 'k=2' coverage factor and a 95% confidence level.

Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Preliminary Graphs

The graphs shown below are maximized peak measurement graphs measured with a resolution bandwidth greater than or equal to the final required detector over a full 0-360°. This peaking process is done as a worst case measurement and enables the detection of frequencies of concern for final measurement. For final measurements with the appropriate detector, where applicable, please refer to the tables under Final Measurements.


In accordance with FCC Part 15, Subpart A, Section 15.33, the device was scanned to the 10th harmonic.

Devices scanned may be scanned at alternate test distances and in accordance with FCC Part 15, Subpart A, Section 15.31, an extrapolation factor of 20 dB/decade was used above 30 MHz and 40 dB/decade below 30 MHz. For example for 1 meter measurements, an extrapolation factor 9.5 dB from 20 Log (1m / 3m) is applied. Except where stated, measurements are performed at a 3m measurement distance.

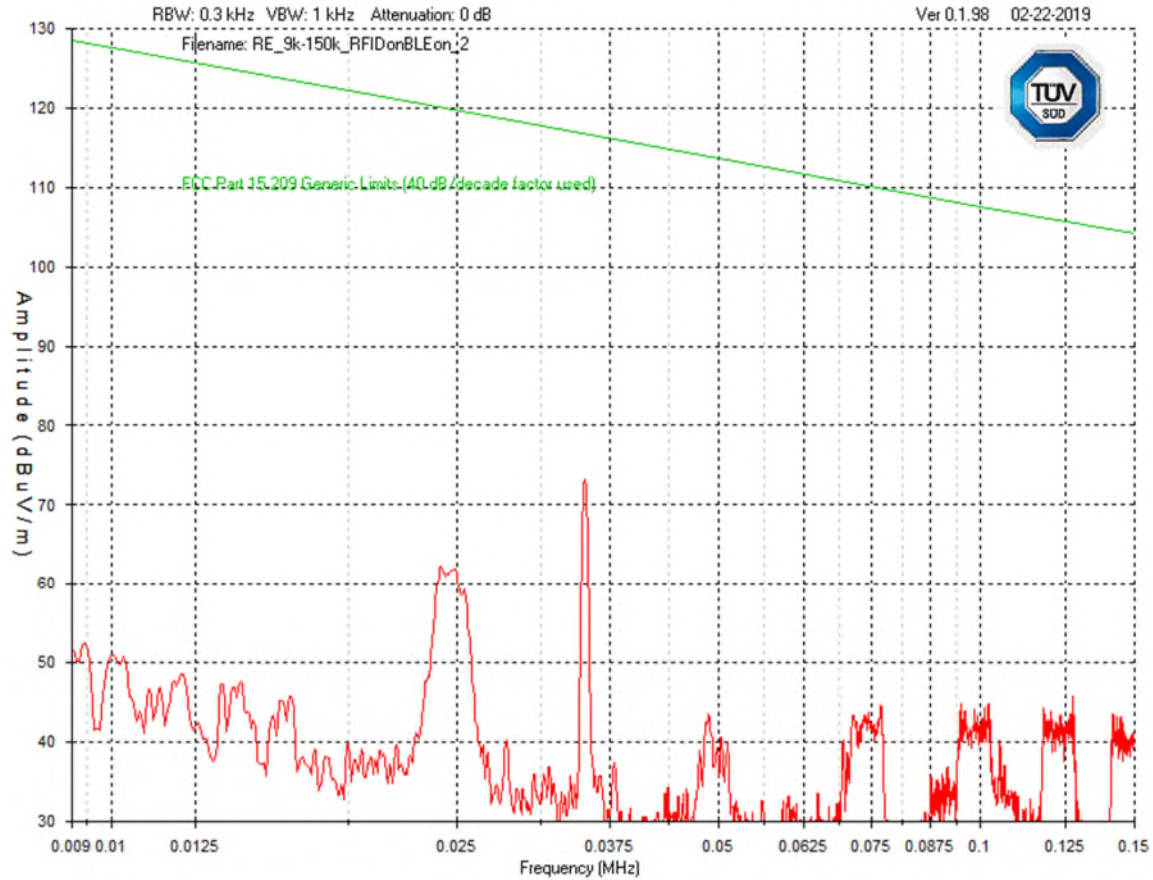
Low, middle and high channels, in the three orthogonal axis were investigated. Worst case graphs are presented.


All transmitters in the EUT are on and transmitting continuous modulated data at the maximum power setting used by the manufacturer.

Band-edge measurement graphs are also shown for illustration purposes. See final measurement section for all measurements.

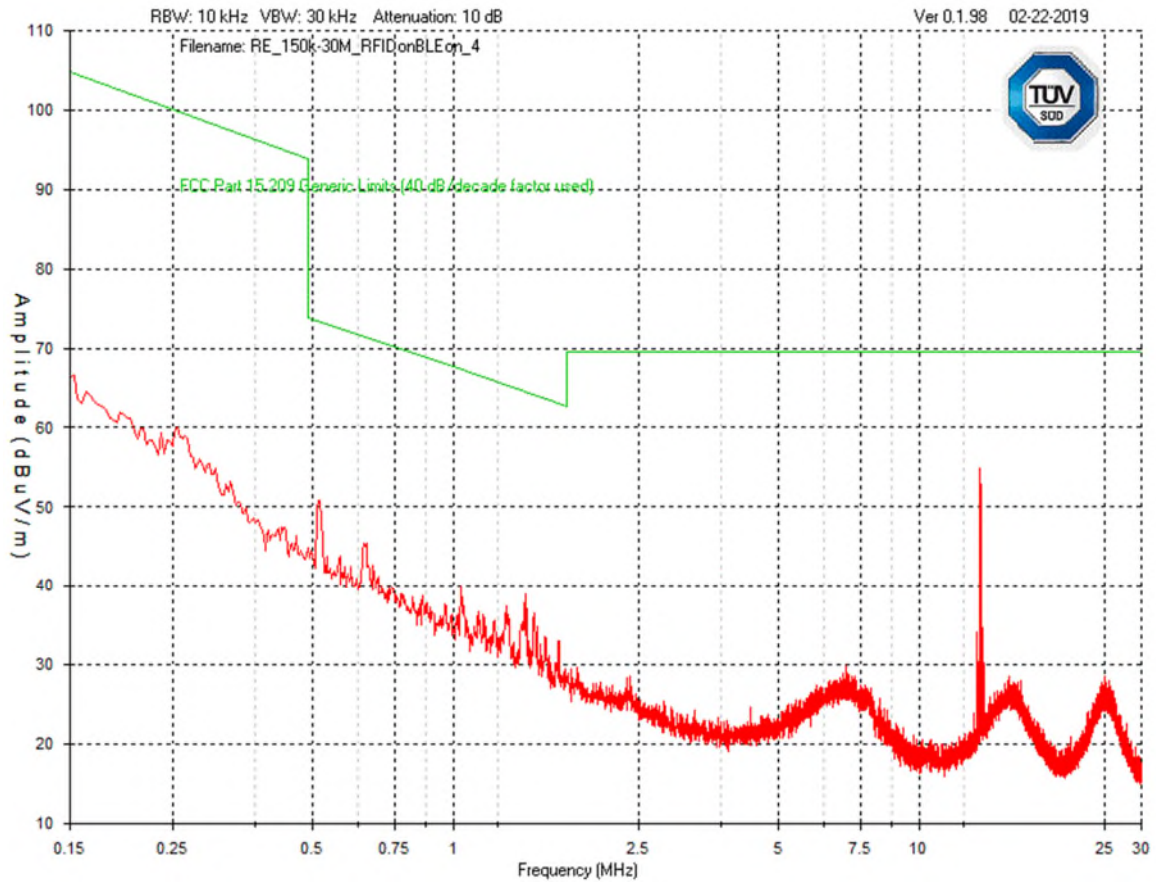
Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	


9 kHz – 150 kHz
Peak Emission Graph



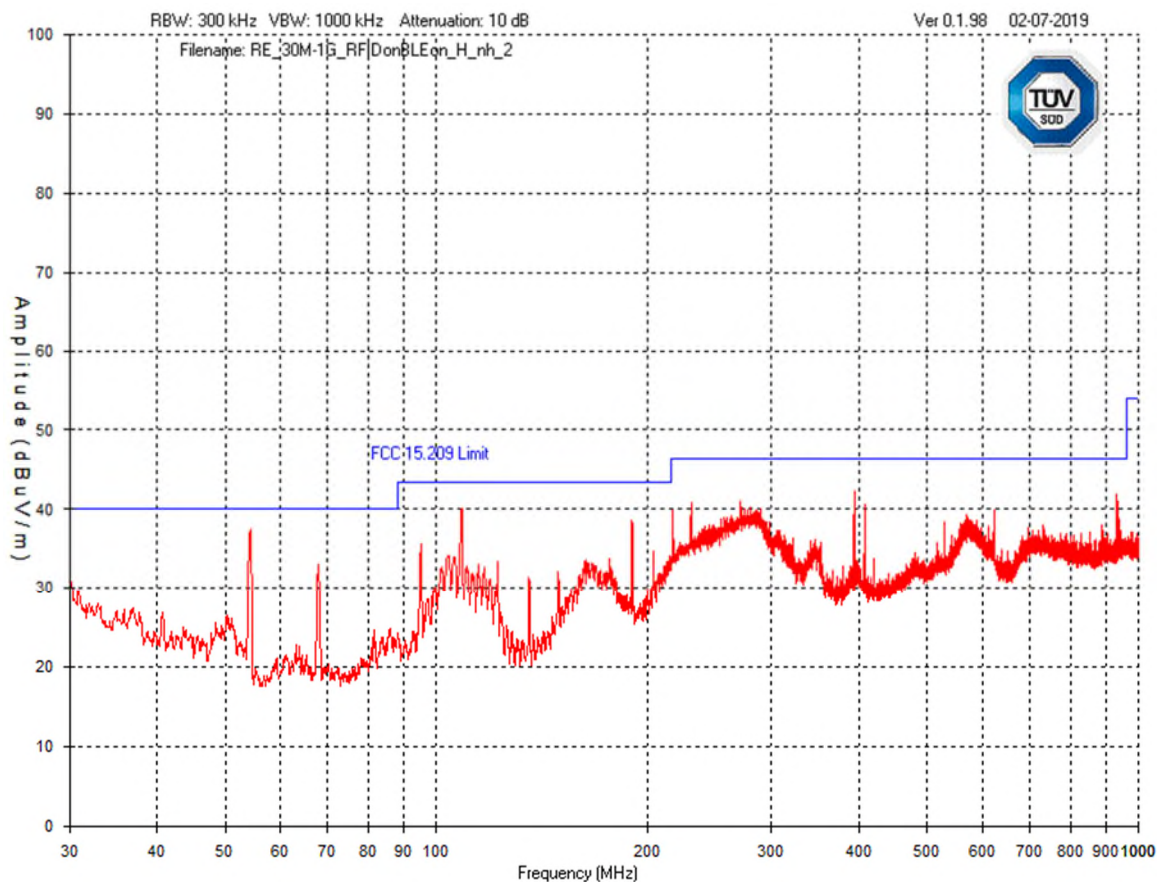
Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	


150 kHz – 30 MHz
Peak Emission Graph



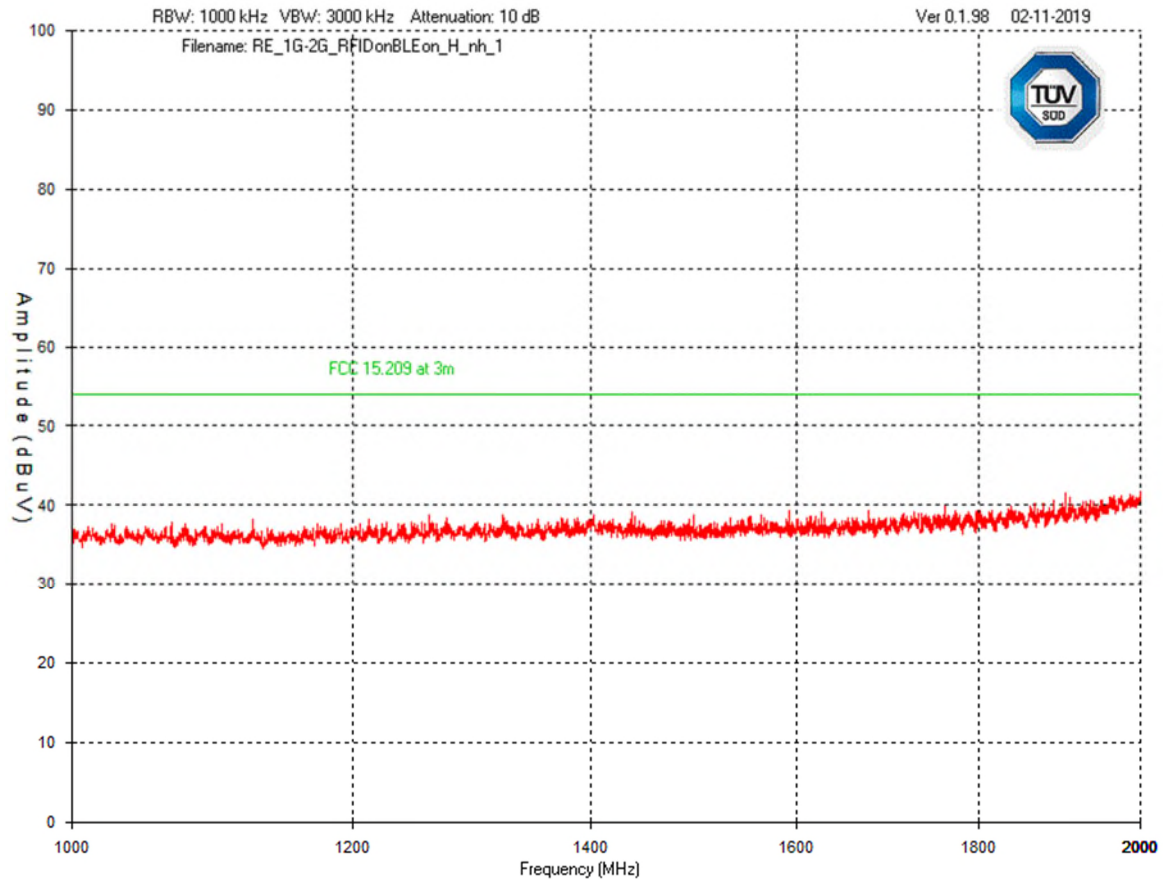
Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	


30 MHz – 1 GHz
Horizontal - Peak Emission Graph



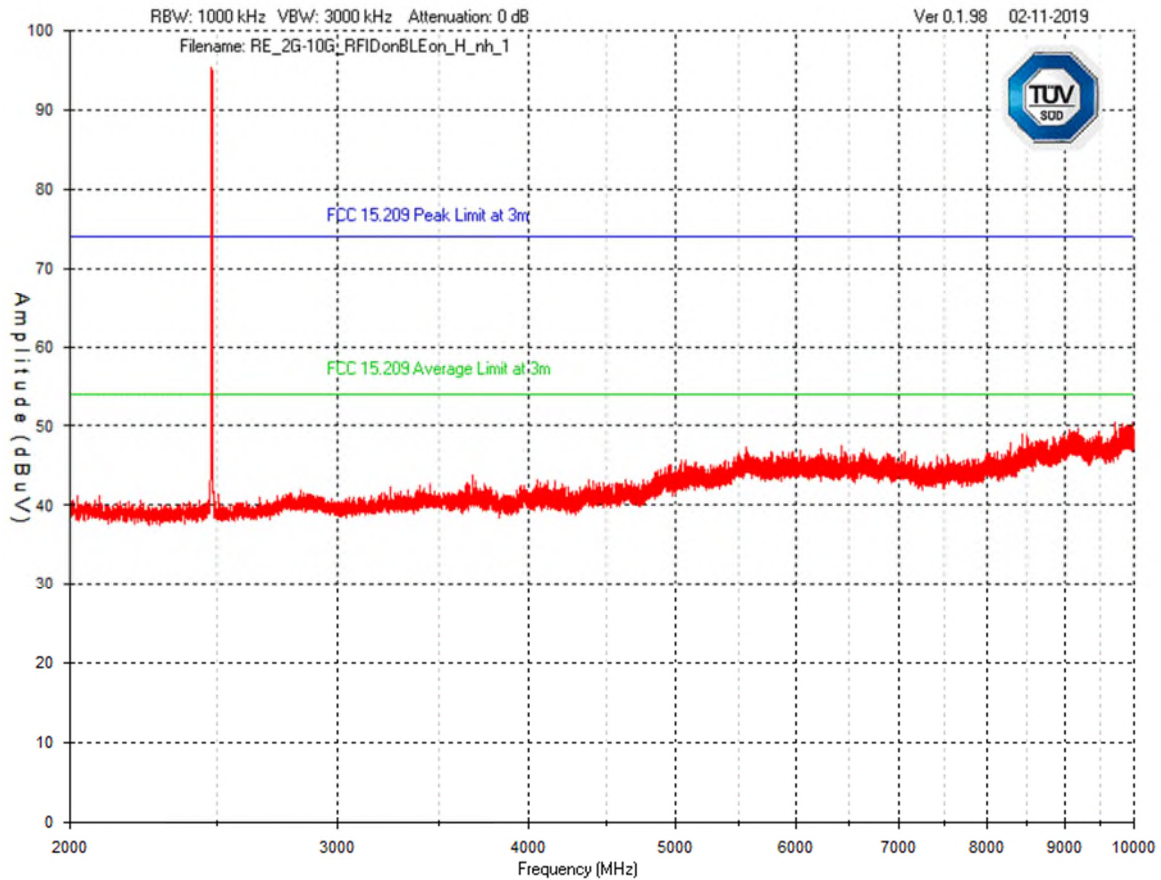
Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	


1 GHz – 2 GHz
Horizontal - Peak Emission Graph



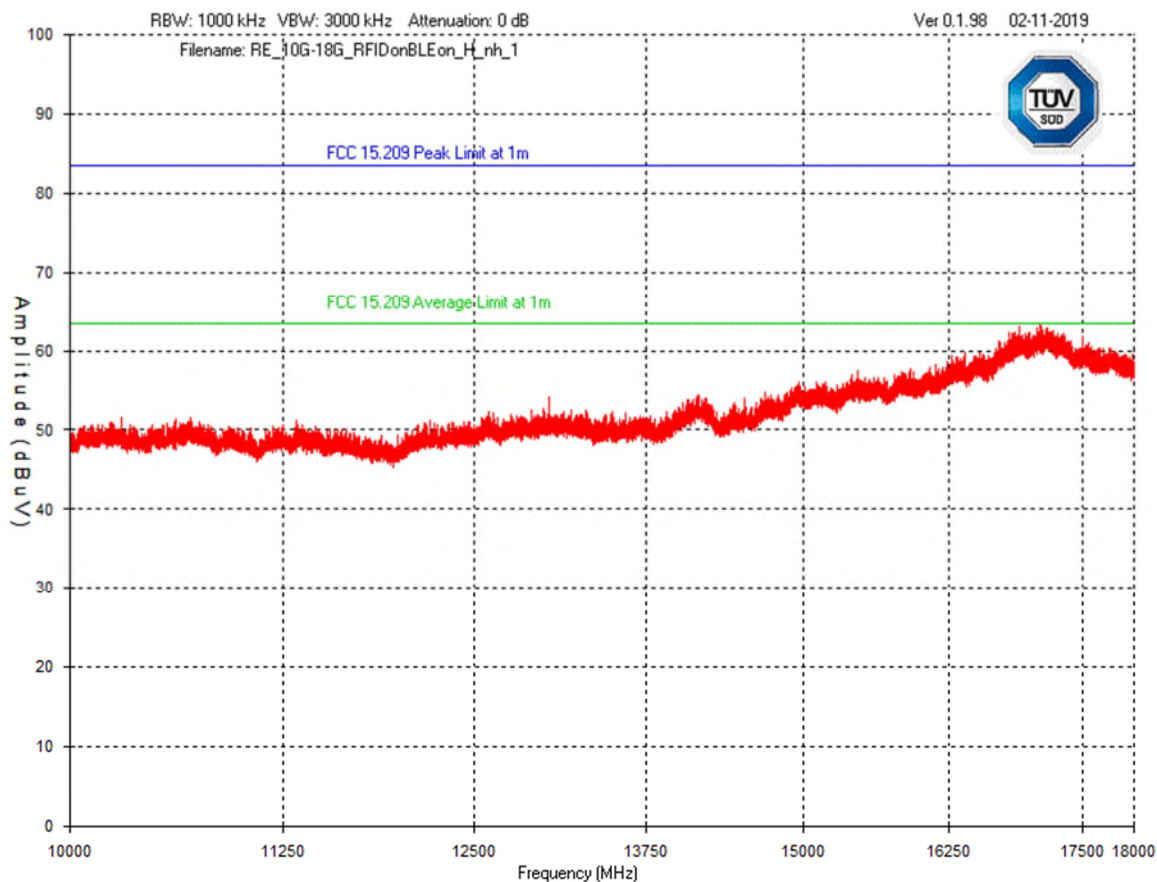
Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

2 GHz – 10 GHz
Horizontal - Peak Emission Graph




Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

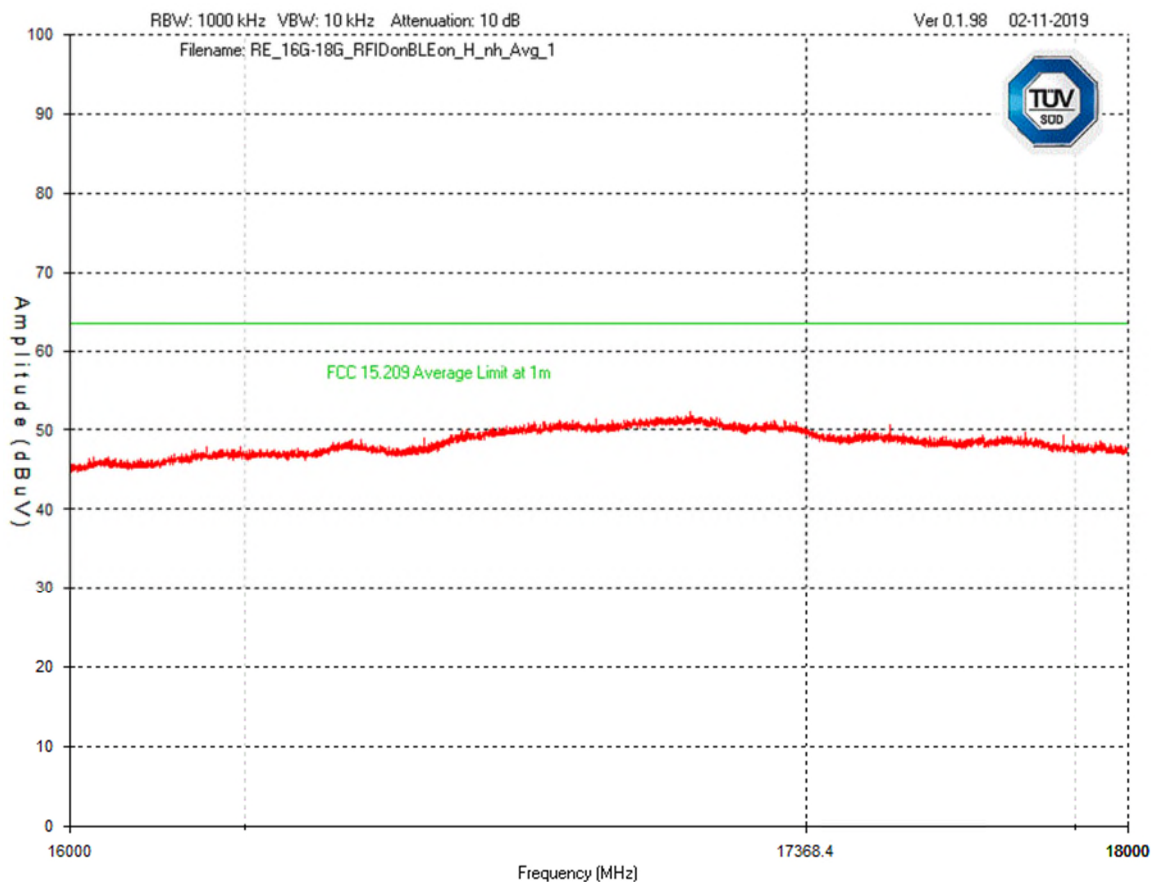
10 GHz – 18 GHz
Horizontal - Peak Emission Graph




Plot was taken at a 1 meter distance.

Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

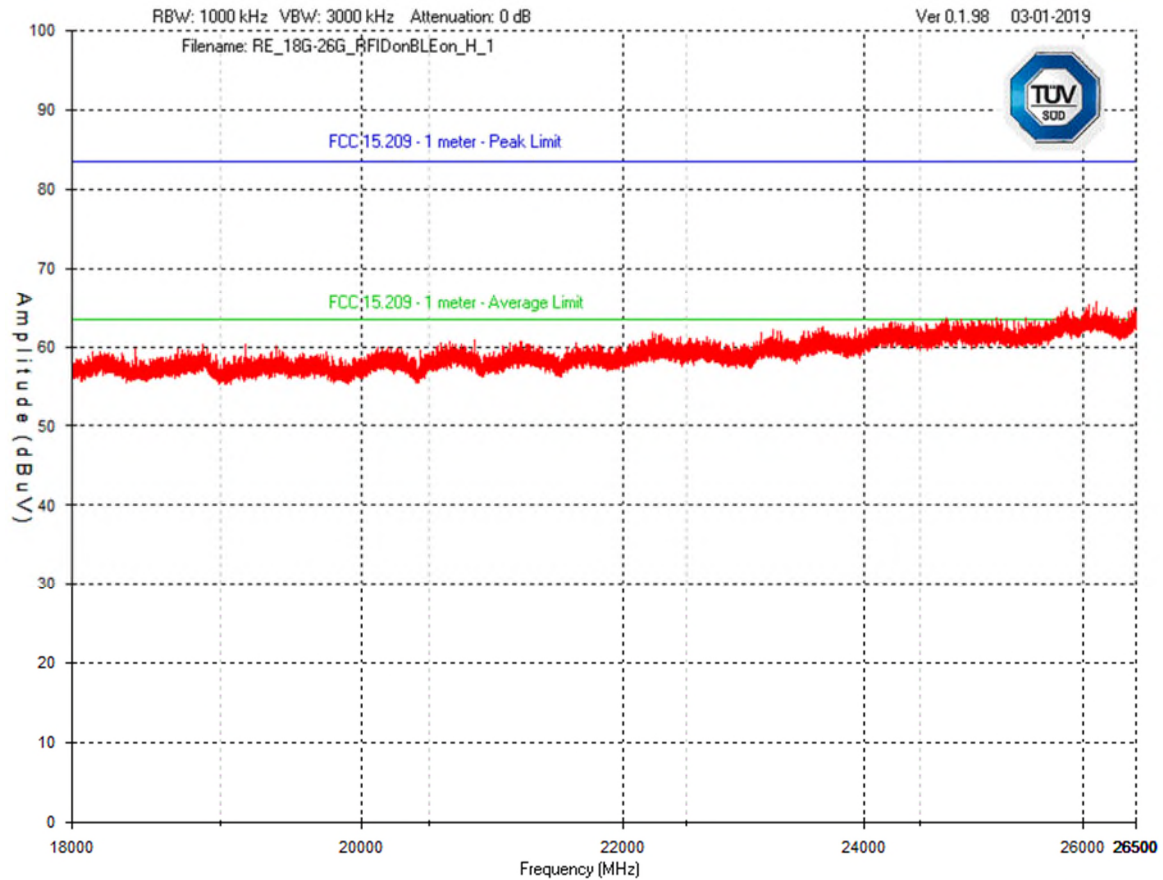
16 GHz – 18 GHz
Horizontal - Average Emission Graph




Plot was taken at a 1 meter distance.

Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

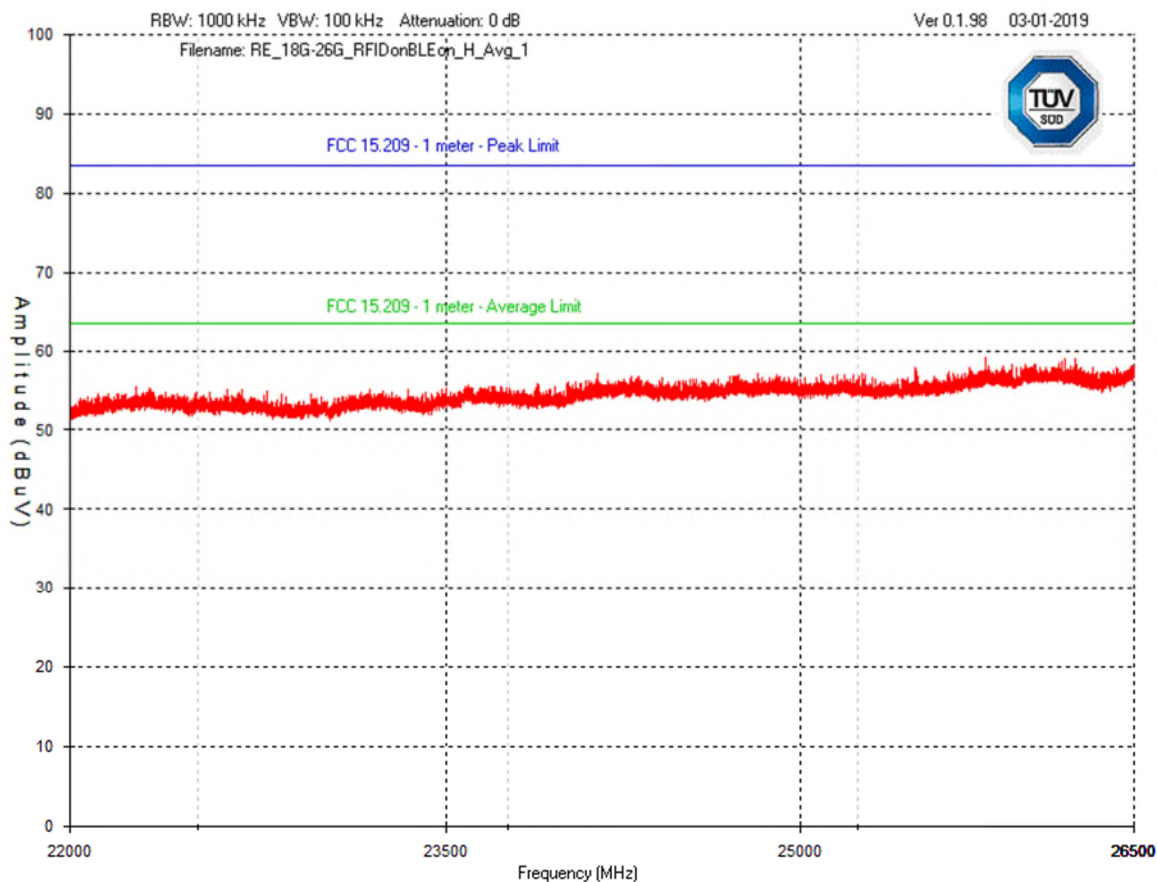
18 GHz – 26.5 GHz
Horizontal - Peak Emission Graph




Plot was taken at a 1 meter distance.

Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

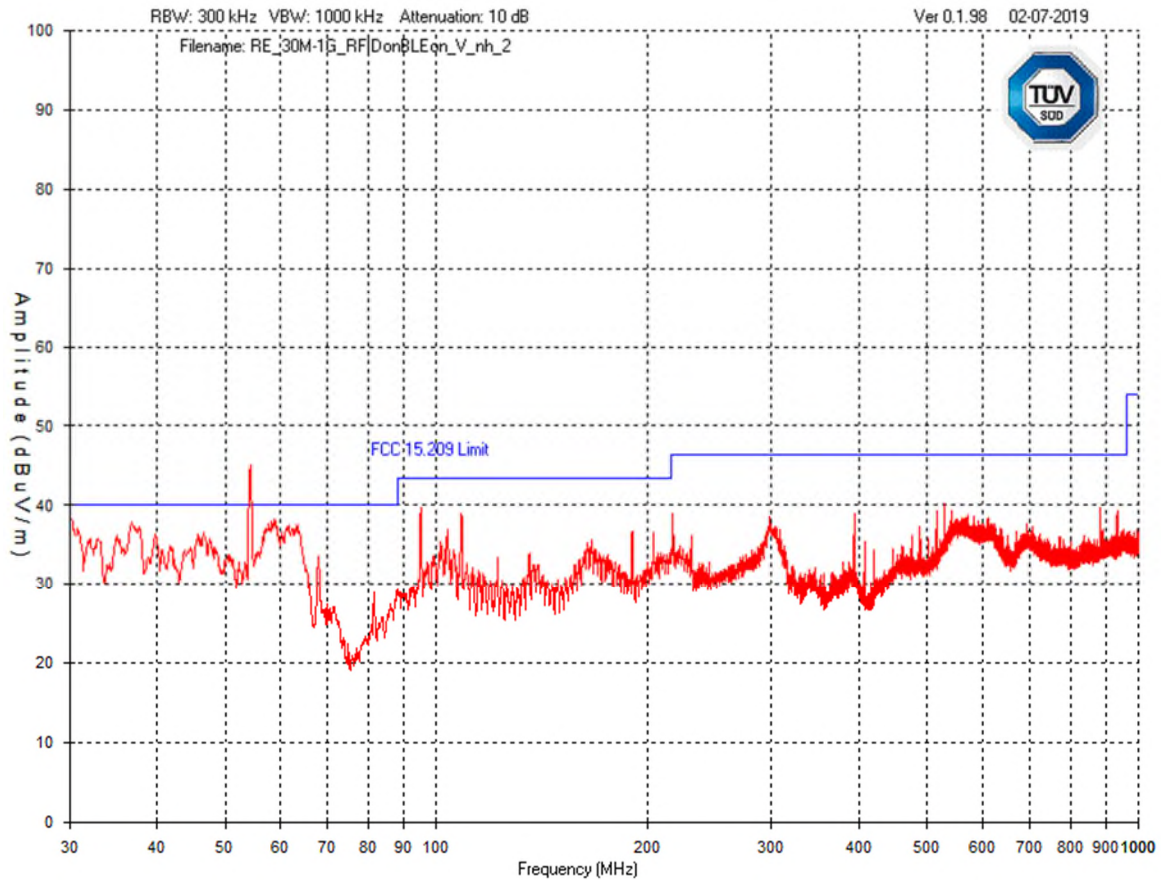
22 GHz – 26.5 GHz
Horizontal - Average Emission Graph




Plot was taken at a 1 meter distance.

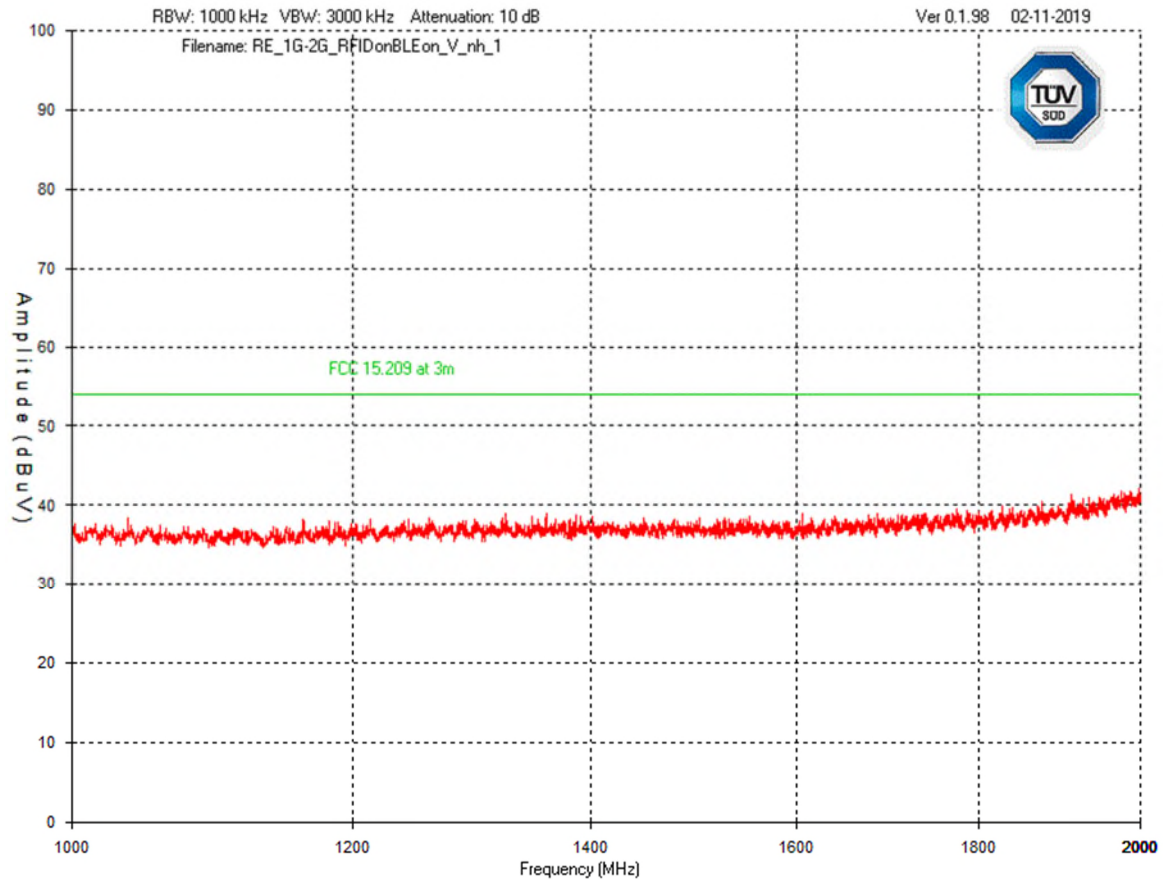
Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	


30 MHz – 1 GHz
Vertical - Peak Emission Graph



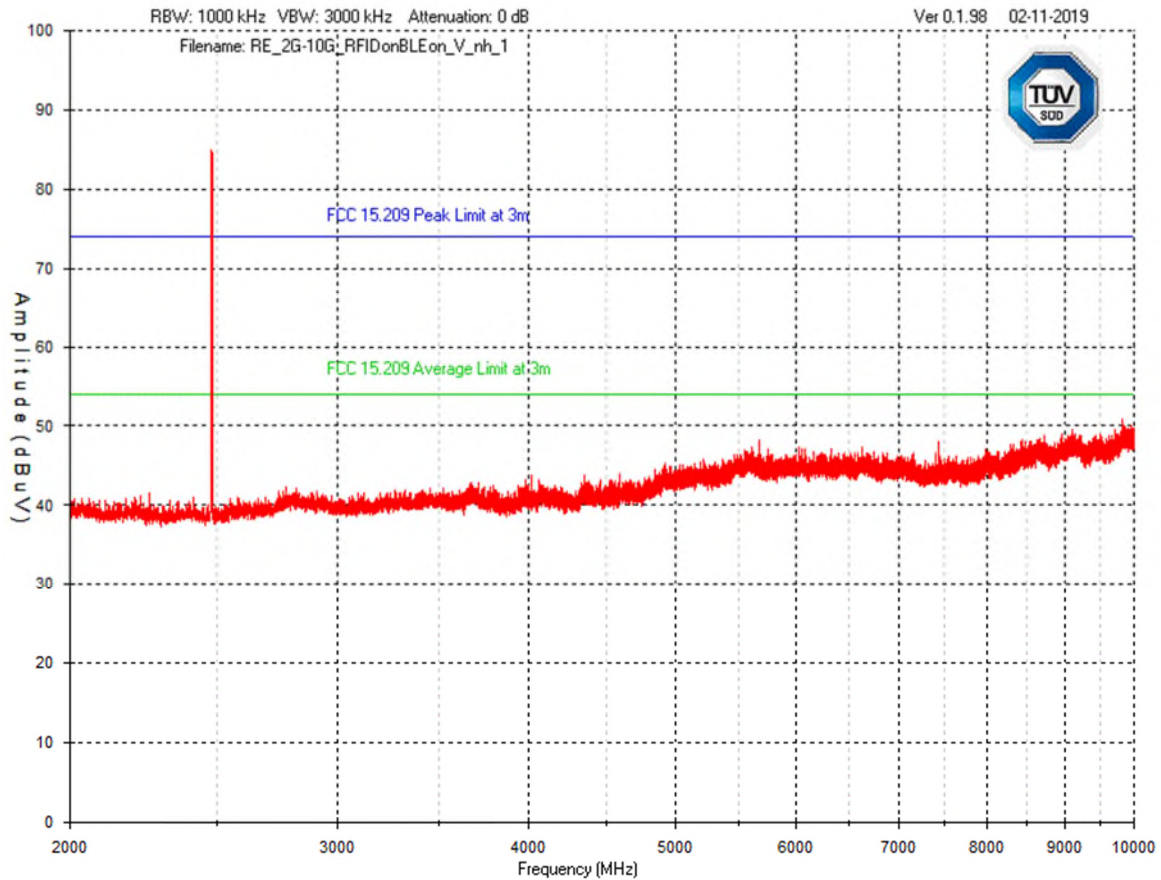
Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	


1 GHz – 2 GHz
Vertical - Peak Emission Graph



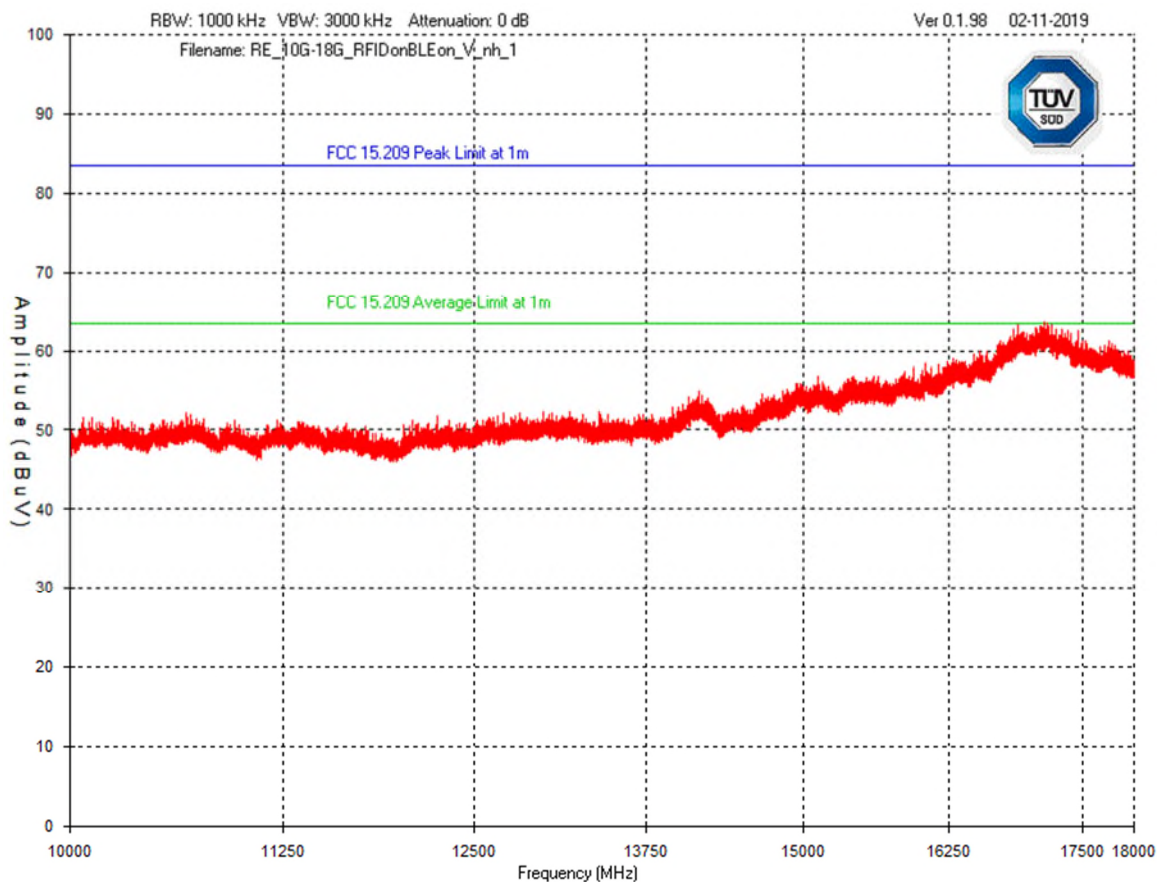
Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

2 GHz – 10 GHz
Vertical - Peak Emission Graph




Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

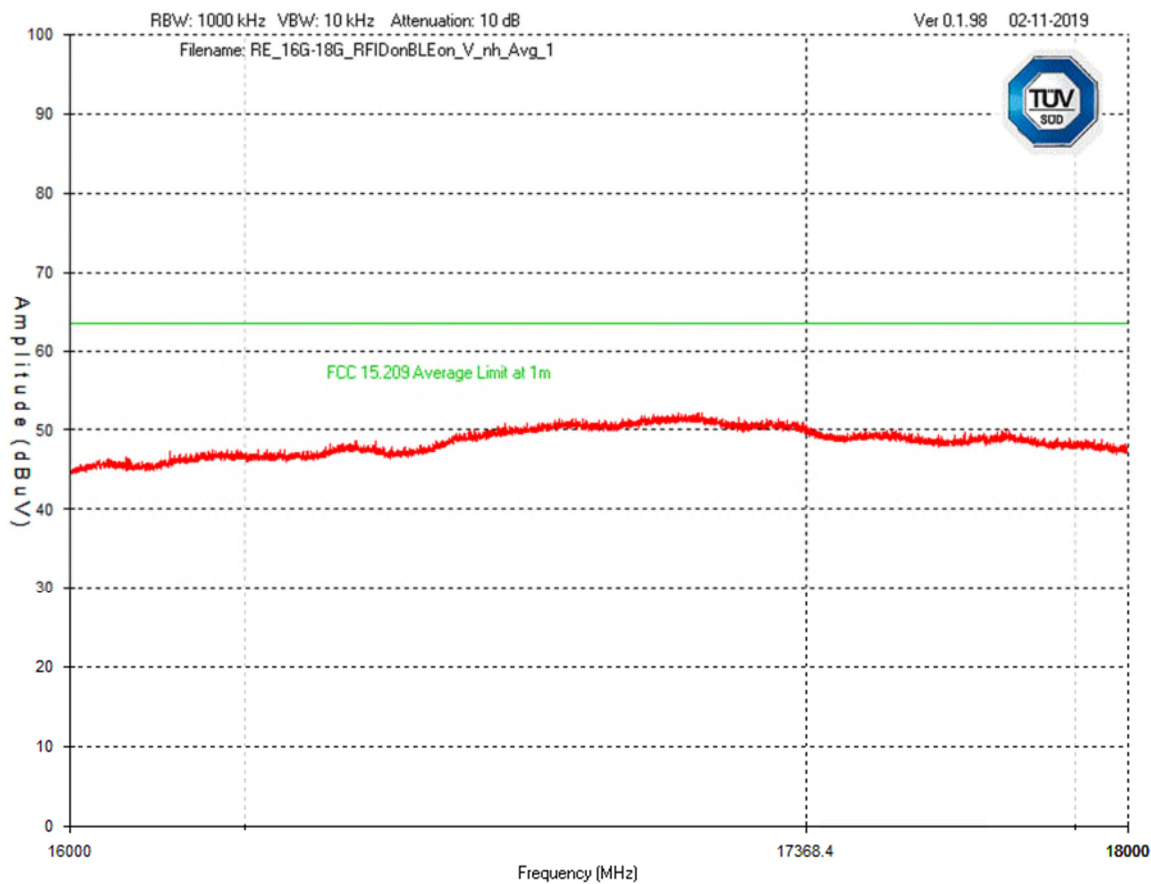
10 GHz – 18 GHz
Vertical - Peak Emission Graph




Plot was taken at a 1 meter distance.

Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

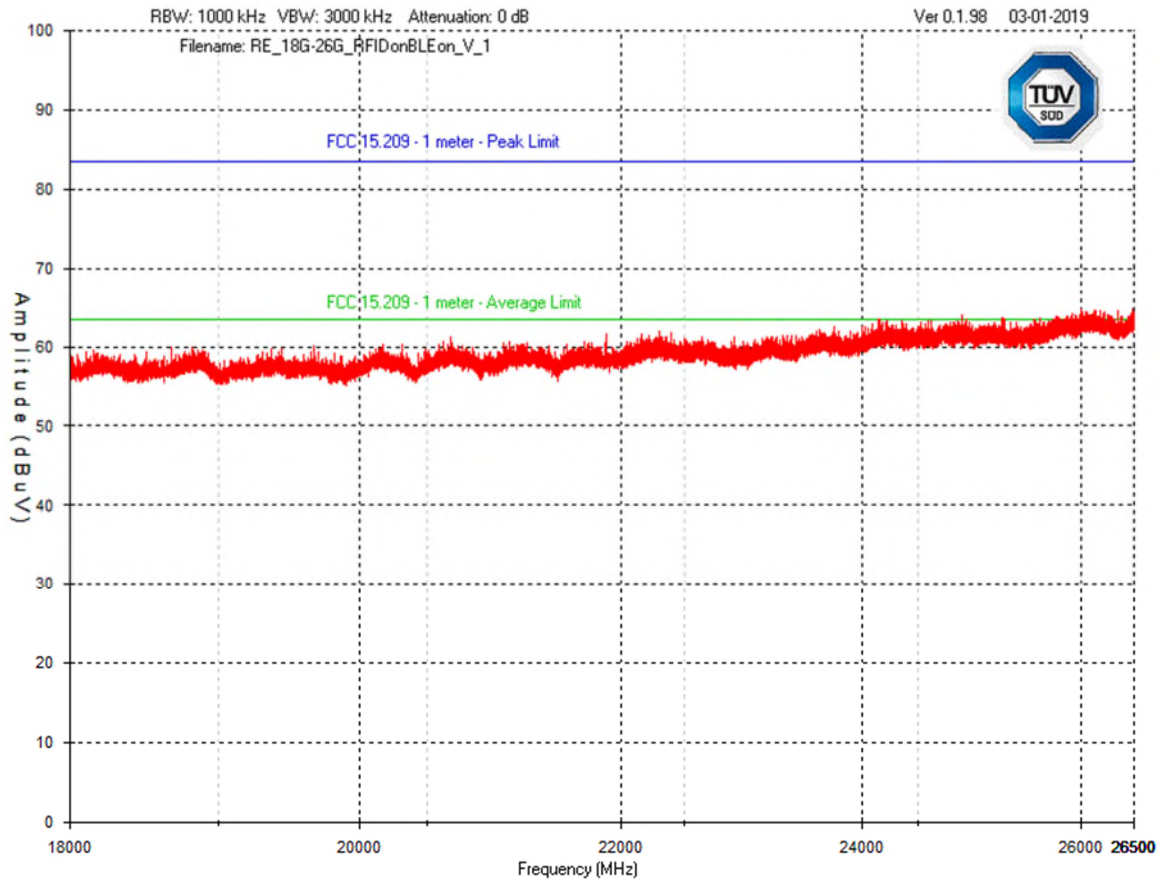
16 GHz – 18 GHz
Vertical - Average Emission Graph




Plot was taken at a 1 meter distance.

Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

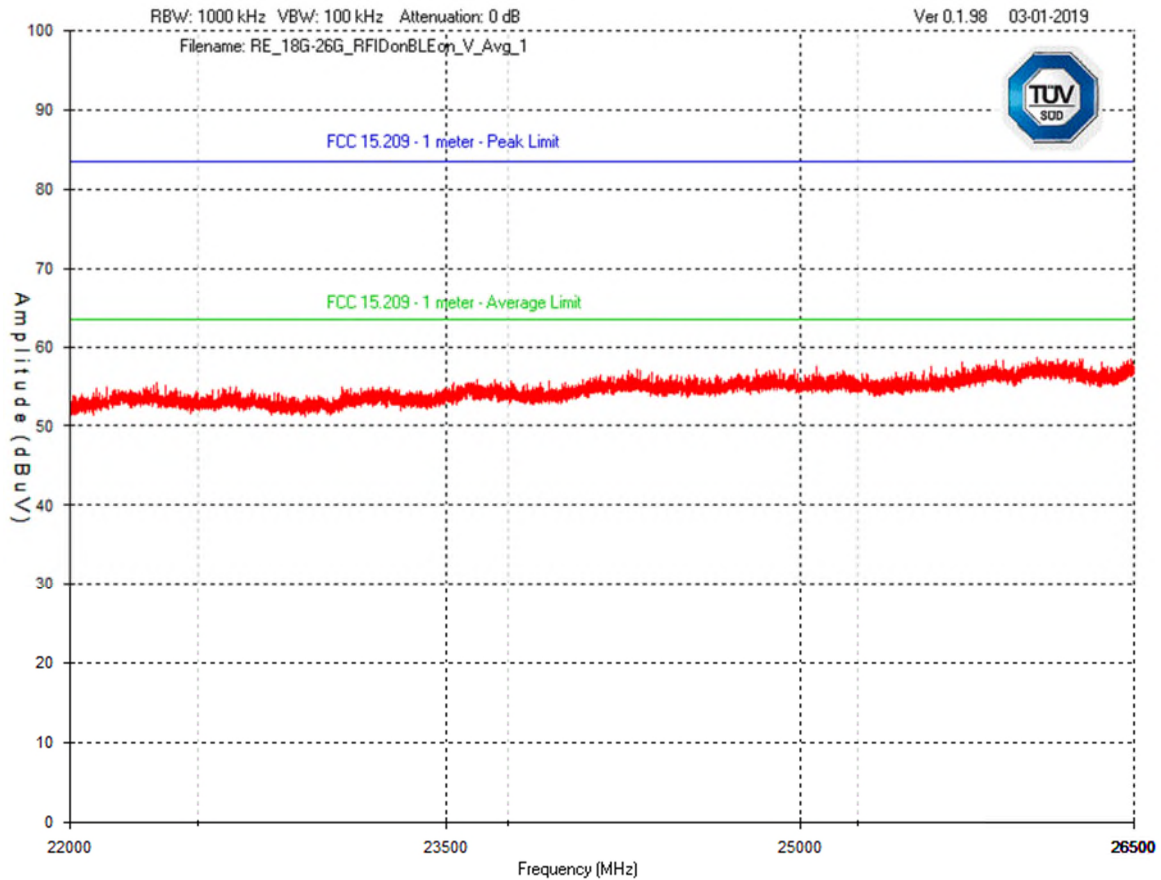
18 GHz – 26.5 GHz
Vertical - Peak Emission Graph




Plot was taken at a 1 meter distance.

Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

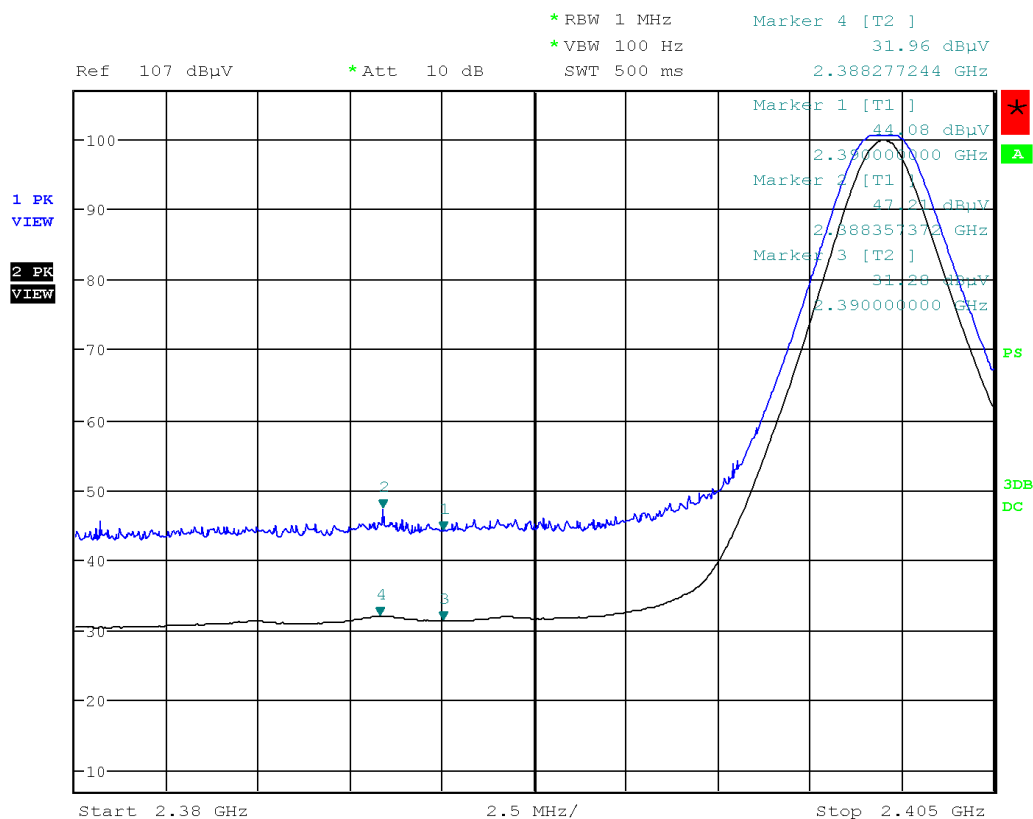
22 GHz – 26.5 GHz
Vertical - Average Emission Graph




Plot was taken at a 1 meter distance.

Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

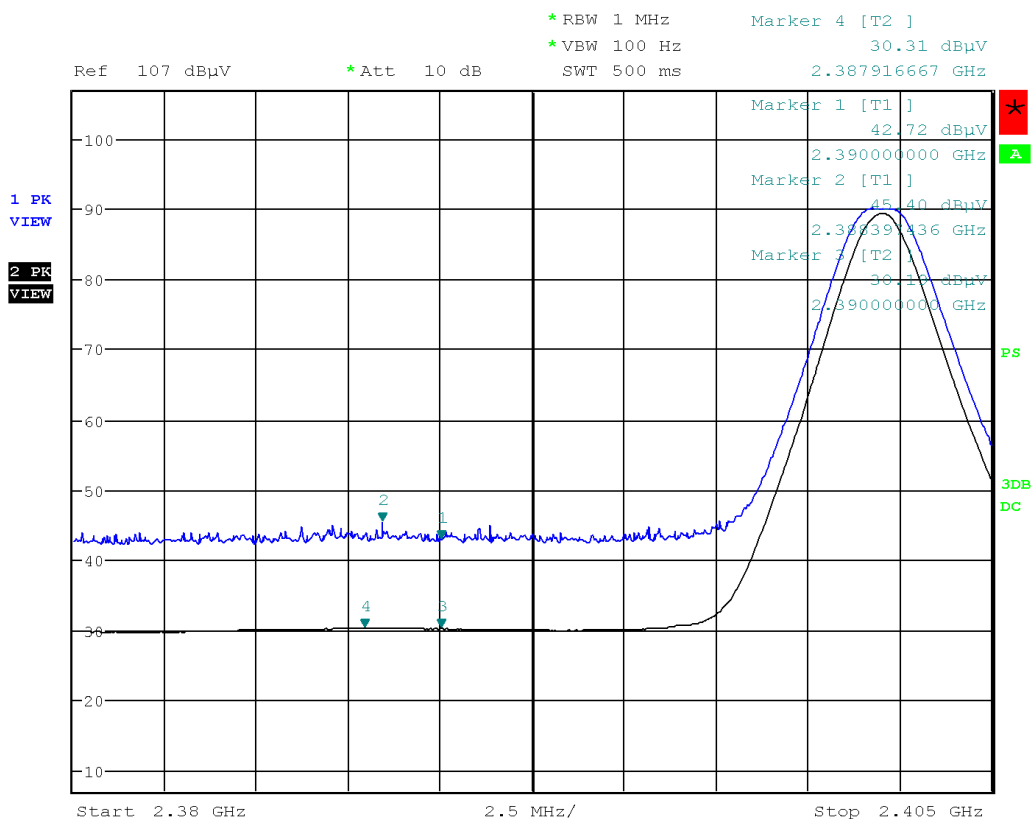
Band Edge – Low Channel Horizontal – Peak & Average Emissions




Note: Restricted Band Edge plot was taken at a 3m measurement distance. The marker values do not have factors applied. See table in *Final Measurements and Results* for final factored values.

Client	Square Inc.	 Canada
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

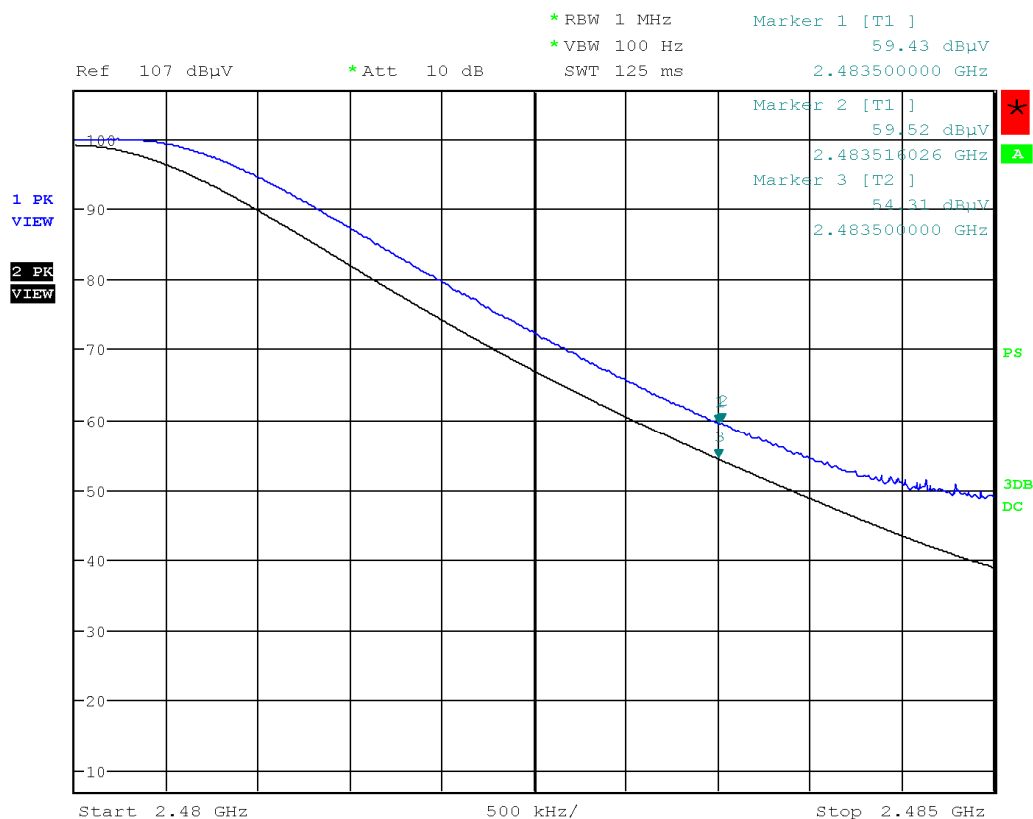
Band Edge – Low Channel Vertical – Peak & Average Emissions




Note: Restricted Band Edge plot was taken at a 3m measurement distance. The marker values do not have factors applied. See table in *Final Measurements and Results* for final factored values.

Client	Square Inc.	 Canada
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

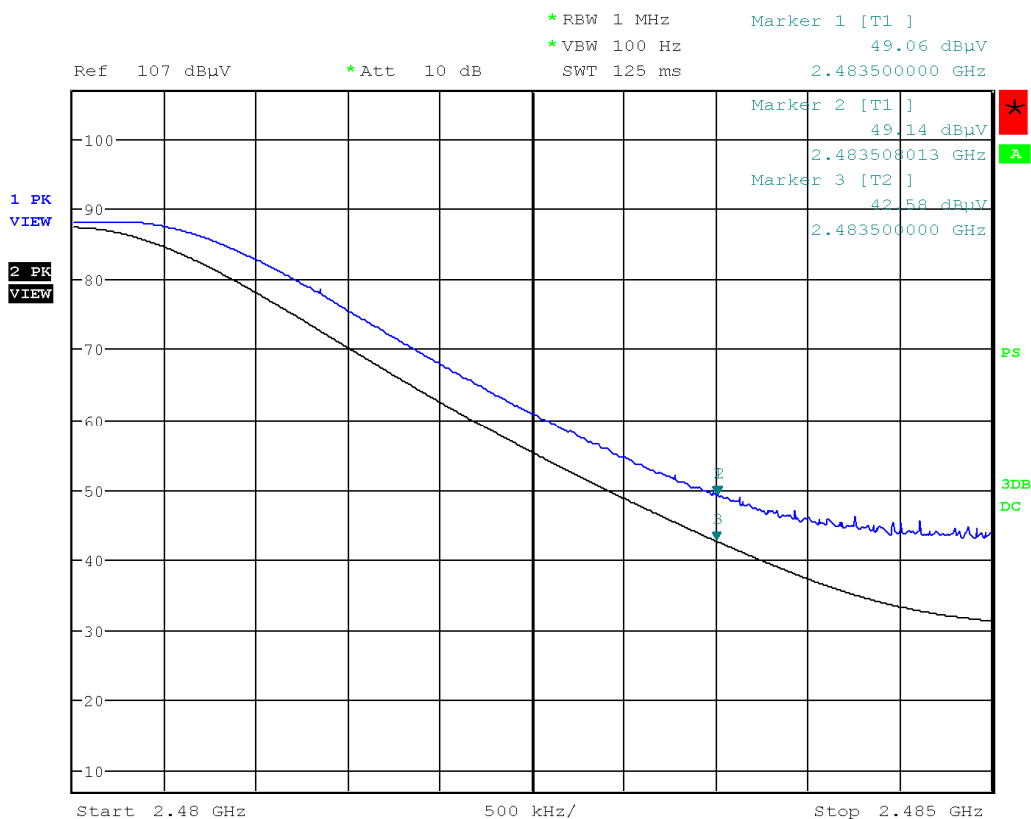
Band Edge – High Channel Horizontal – Peak & Average Emissions



Note: Restricted Band Edge plot was taken at a 3m measurement distance. The marker values do not have factors applied. See table in *Final Measurements and Results* for final factored values.

Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Band Edge – High Channel Vertical – Peak & Average Emissions



Note: Restricted Band Edge plot was taken at a 3m measurement distance. The marker values do not have factors applied. See table in *Final Measurements and Results* for final factored values.

Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Final Measurements and Results

The EUT passed. Low, middle, and high bands were measured.

In accordance with 15.247(d), only frequencies exceeding the 15.209 limit that occur within the bands listed in 15.205 need to be verified with a final detector. Emissions outside the restricted bands were measured for informational purposes.

The measurements were maximized by rotating the turn table over a full 0-360° rotation and the antenna height was varied from 1 m to 4 m.

Spurious Radiated Emissions Table

Frequency (MHz)	Detector	Received Signal (dBμV)	Antenna Factor (dB/m)	Atten Factor (dB)	Cable Factor (dB)	Pre-Amp (dB)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Pass/Fail
Horizontal Antenna Polarization										
54.27	QP	55.3	7.8	6	0.5	-32.0	37.6	40.0	2.4	Pass
108.55	QP	55.6	7.9	6	0.8	-32.0	38.3	43.5	5.2	Pass
393.43	QP	44.1	16.3	6	1.6	-31.9	36.1	46.4	10.3	Pass
931.55	QP	36.4	23.7	6	2.6	-30.7	38.0	46.4	8.4	Pass
189.92	QP	51.5	10.1	6	1.0	-32.0	36.6	43.5	6.9	Pass
230.51	QP	49.2	11.9	6	1.1	-32.0	36.2	46.4	10.2	Pass
Vertical Antenna Polarization										
54.27	QP	57.2	7.8	6	0.5	-32.0	39.5	40.0	0.5	Pass
58.62	QP	47.7	7.2	6	0.6	-32.0	29.5	40.0	10.5	Pass
63.17	QP	46.1	6.9	6	0.6	-32.0	27.6	40.0	12.4	Pass
30.10	QP	43.5	17.1	6	0.4	-32.1	34.9	40.0	5.1	Pass
36.89	QP	45.8	13.5	6	0.5	-32.1	33.7	40.0	6.3	Pass
95.06	QP	54.4	7.7	6	0.8	-32.0	36.9	43.5	6.6	Pass
108.55	QP	51.5	7.9	6	0.8	-32.0	34.2	43.5	9.3	Pass

Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Restricted Band Edges Emissions Table


Test Frequency (MHz)	Detection Mode	Received Signal (dBμV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-Amp Gain (dB)	Level (dBμV/m)	Emission Limit (dBμV/m)	Margin (dB)	Result
Low Band Edge Measurements (2390 MHz)									
EUT Low Channel									
Horizontal Antenna Polarity									
2390.00	Peak	44.08	26.5	3.6	-34.2	39.98	74	34.02	Pass
2390.00	Avg.	31.28	26.5	3.6	-34.2	27.18	54	26.82	Pass
2388.36	Peak	47.21	26.5	3.6	-34.2	43.11	74	30.89	Pass
2388.28	Avg.	31.96	26.5	3.6	-34.2	27.86	54	26.14	Pass
Vertical Antenna Polarity									
2390.00	Peak	42.72	26.6	3.6	-34.2	38.72	74	35.28	Pass
2390.00	Avg.	30.19	26.6	3.6	-34.2	26.19	54	27.81	Pass
2388.40	Peak	45.4	26.6	3.6	-34.2	41.4	74	32.6	Pass
2387.92	Avg.	30.31	26.6	3.6	-34.2	26.31	54	27.69	Pass
High Band Edge Measurements (2483.5 MHz)									
EUT High Channel									
Horizontal Antenna Polarity									
2483.50	Peak	59.43	26.3	3.6	-34.2	55.13	74	18.87	Pass
2483.50	Avg.	54.31	26.3	3.6	-34.2	50.01	54	3.99	Pass
2483.52	Peak	59.52	26.3	3.6	-34.2	55.22	74	18.78	Pass
Vertical Antenna Polarity									
2483.5	Peak	49.06	26.2	3.6	-34.2	44.66	74	29.34	Pass
2483.50	Avg.	42.58	26.2	3.6	-34.2	38.18	54	15.82	Pass
2483.51	Peak	49.14	26.2	3.6	-34.2	44.74	74	29.26	Pass

Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	


Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration / Verification Date	Next Calibration / Verification Date	Asset #
Spectrum Analyzer	ESU 40	Rohde & Schwarz	Jan. 12, 2018	Jan. 12, 2020	GEMC 233
Loop Antenna 9 – 150 kHz	EM 6871	Electro-Metrics	Feb 15, 2019	Feb 15, 2021	GEMC 70
Loop Antenna 150 kHz – 30 MHz	EM 6872	Electro-Metrics	Feb 15, 2019	Feb 15, 2021	GEMC 71
BiLog Antenna 30 MHz – 1 GHz	3142-C	ETS	Oct. 19, 2018	Oct. 19, 2020	GEMC 8
Horn Antenna 1 – 2 GHz	HRN-0118	TDK RF Solutions	Feb. 13, 2018	Feb. 13, 2020	GEMC 235
Horn Antenna 2 – 18 GHz	WBH218HN	Q-par	Feb. 27, 2018	Feb. 27, 2020	GEMC 6375
Horn Antenna 18 – 26.5 GHz	SAS-572	A.H. Systems	Oct 23, 2018	Oct 23, 2020	GEMC 6371
Pre-Amp 9 kHz – 1 GHz	CPA9230	Chase	Feb. 28, 2018	Feb. 28, 2020	GEMC 301
Pre-Amp 1 – 26.5 GHz	HP 8449B	HP	Nov. 15, 2017	Nov. 15, 2019	GEMC 189
Attenuator 6 dB	612-6-1	Meca Electronics, Inc	NCR	NCR	GEMC 286
RF Cable 10m	LMR-400-10M-50Ω-MN-MN	LexTec	NCR	NCR	GEMC 274
RF Cable 2m	Sucoflex 104A	Huber+Suhner	NCR	NCR	GEMC 271
Emissions Software	0.1.97	Global EMC	NCR	NCR	GEMC 58

FCC - 15.209 -Radiated Emissions_Rev1

Client	Square Inc.	 Canada
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Appendix A – EUT Summary

Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	


For further details refer to filing package.

General EUT Description

Client Details	
Organization / Address	Square Inc. 1455 Market St. Suite 600 San Francisco, CA USA 95014
Contact	Gavin Demonte
Phone	416-319-7479
Email	gavin@squareup.com
EUT (Equipment Under Test) Details	
EUT Name	Wireless card reader
EUT Model	SPC1
EUT is powered using	Internal rechargeable battery charged using USB cable.
Input voltage (V)	USB: 5 VDC Internal rechargeable battery: 3.7 VDC (nominal)
Rated input current (A)	0.5 A
Frequency range(s) (Hz)	BLE: 2402-2480 MHz NFC: 13.56 MHz
Nominal power consumption (W)	2.5 W (max for USB)
Transmits RF energy? (describe)	Bluetooth LE transceiver NFC transceiver
Basic EUT functionality description	Wireless card reader accepting NFC contactless payments and EMV chip card transactions
Modes of operation	Bluetooth LE: 2402-2480 MHz, GFSK modulation. NFC: 13.56 MHz, ASK modulation.
Frequency of all clocks present in EUT	32.768 kHz, 24 MHz, 27.12 MHz
I/O cable description	30 cm micro-USB-to-Type-A cable
Available connectors on EUT	Micro-USB
Peripherals required to exercise EUT	S089 stand MacBook Pro Model A 1398 (Both provided by manufacturer)
Dimensions of product	L: 67mm, W: 67mm, H: 11mm


Note the EUT is considered to have been received the date of the commencement of the first test, unless otherwise stated.

For close-up pictures of the EUT, see 'Appendix B – EUT and Test Setup Photos'.

Client	Square Inc.	 Canada
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	


Appendix B – EUT and Test Setup Photos

Note: These photos are for information purposes only.
Also refer to submitted files that are separate from this test report.

Client	Square Inc.	 Canada
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	




EUT – External view 1

Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	




EUT – External view 2

Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	




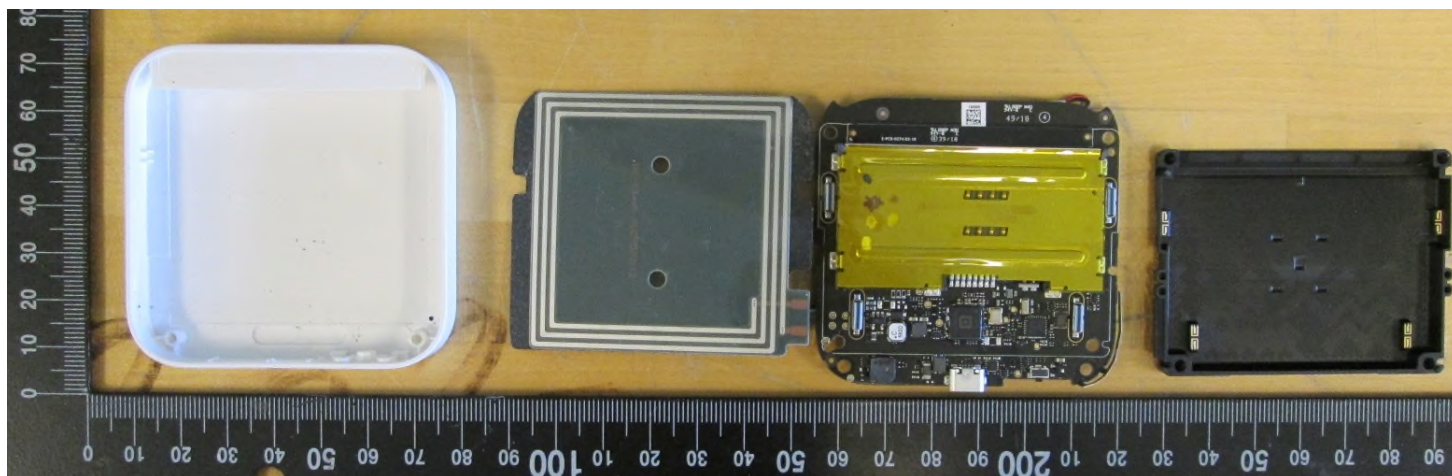
EUT – Internal view 1
Back cover removed.

Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	




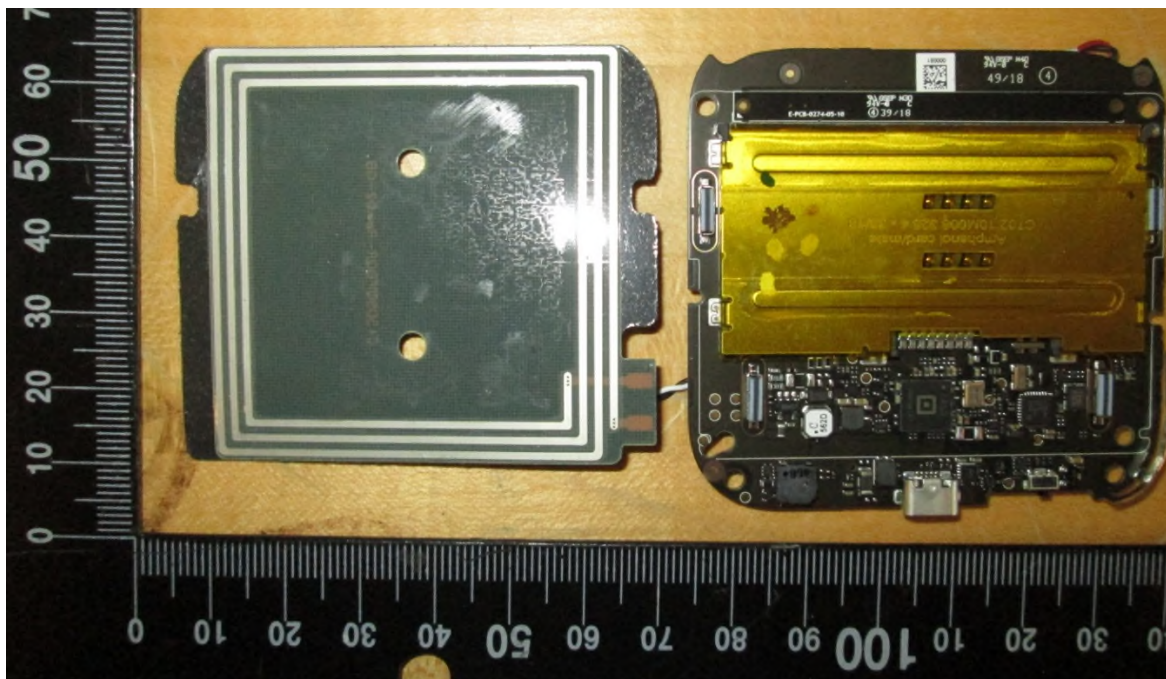
EUT – Internal view 2
PCB removed from enclosure

Client	Square Inc.	 Canada
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	




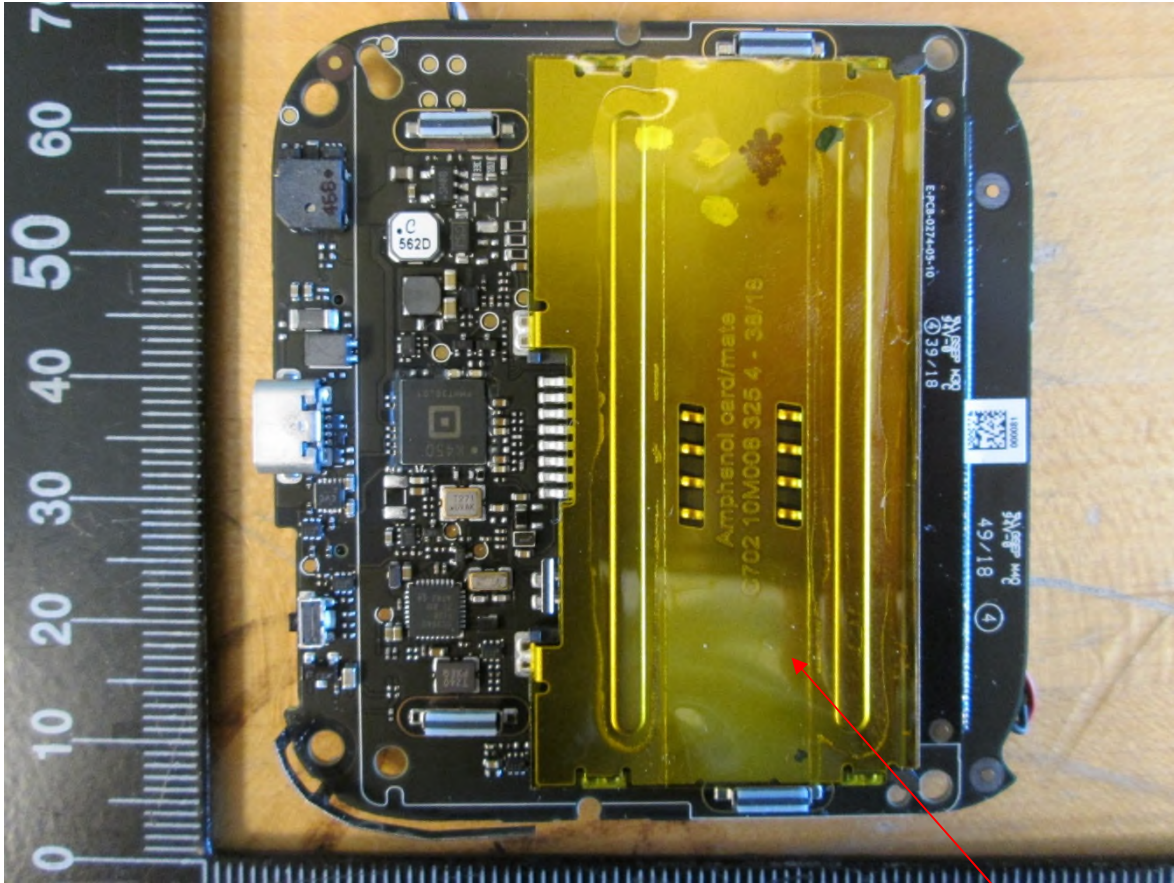
EUT – Internal view 3
Cage removed.
Cover removed over 13.56 MHz antenna.

Client	Square Inc.	 Canada
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	




EUT – Internal view 4
Close-up of PCB, side 1

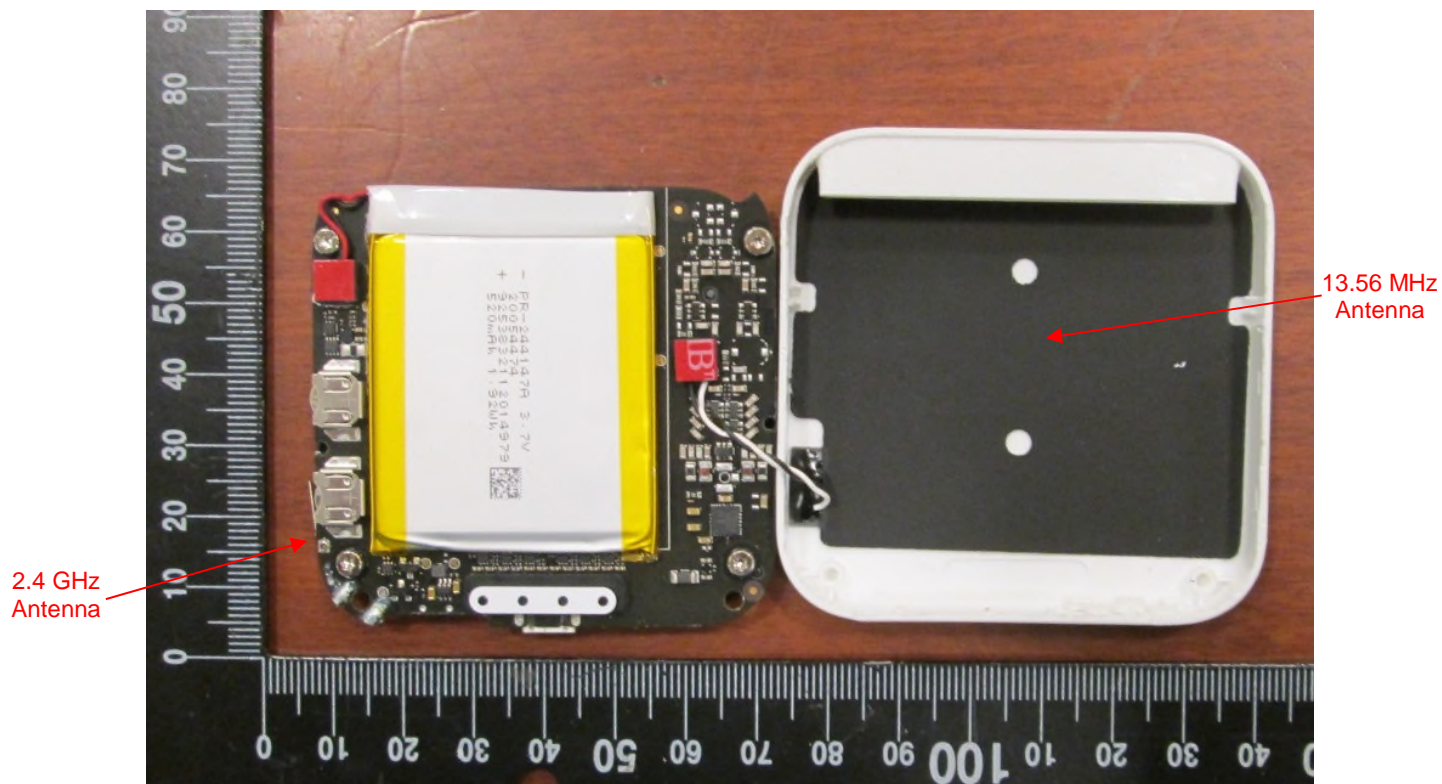
Client	Square Inc.	 Canada
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	




EUT – Internal view 5
Close-up of PCB side 1, alternate view

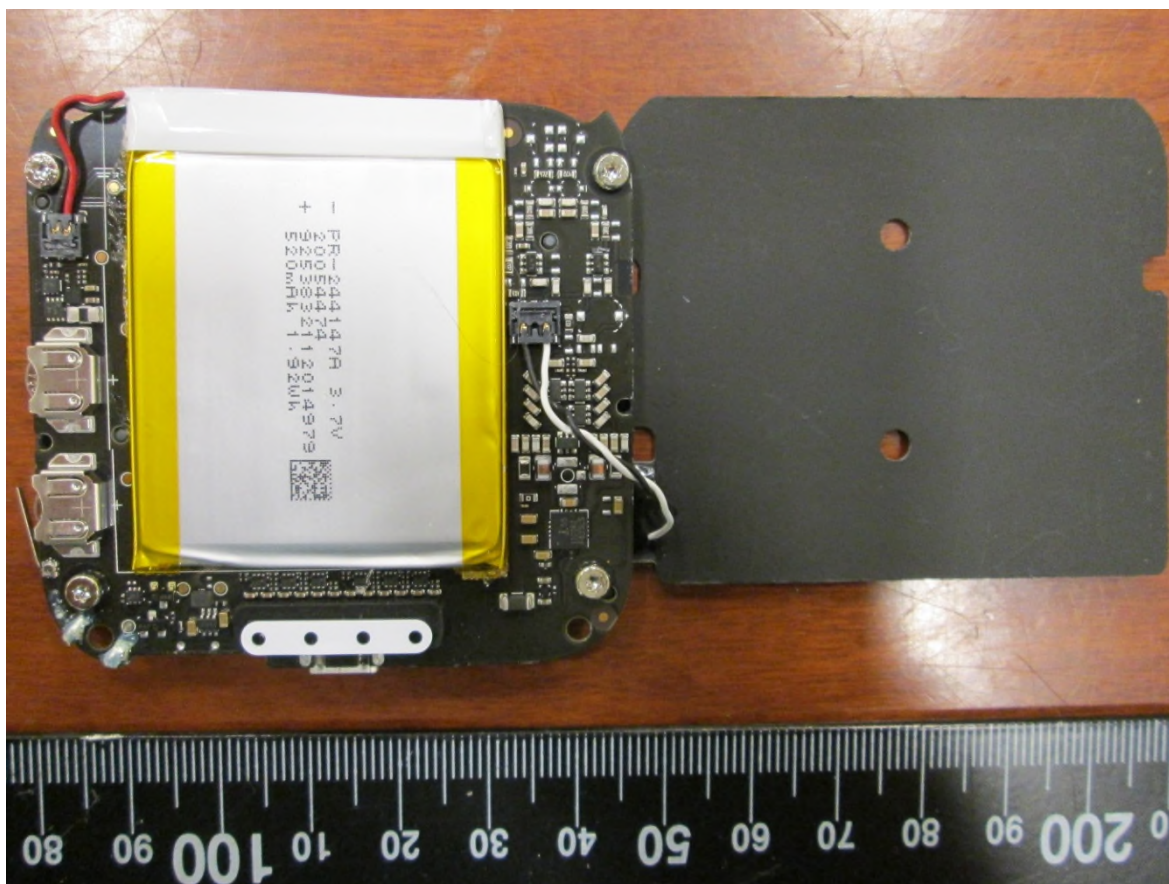
Contact card socket
soldered directly onto the
PCB. Not a shield. No
components under this part.

Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	




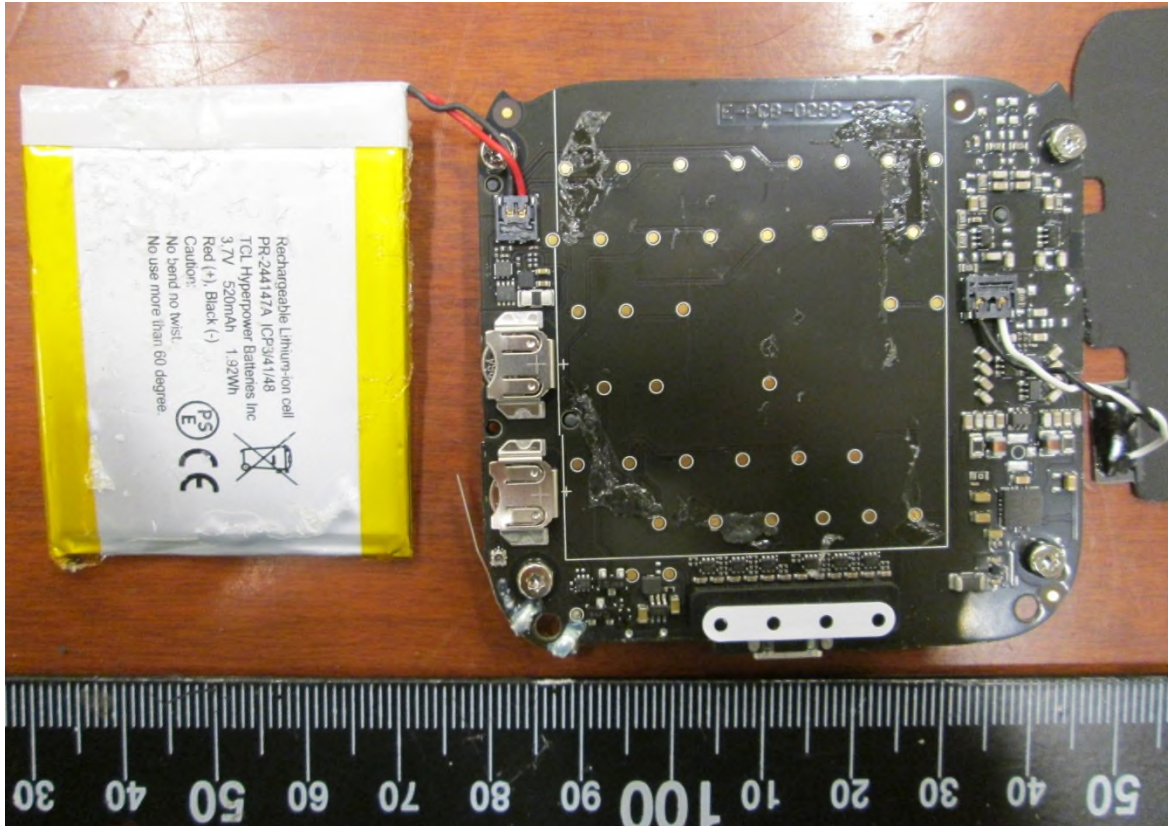
EUT – Internal view 6
PCB removed from enclosure and inverted
PCB side 2 shown.

Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	




EUT – Internal view 7
Close-up of PCB side 2.

Client	Square Inc.	 Canada
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	




EUT – Internal view 8
Close-up of PCB side 2, with battery moved aside.

Client	Square Inc.	 Canada
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	




Test setup photo 1
Radiated measurements, 9 kHz – 30 MHz

Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	




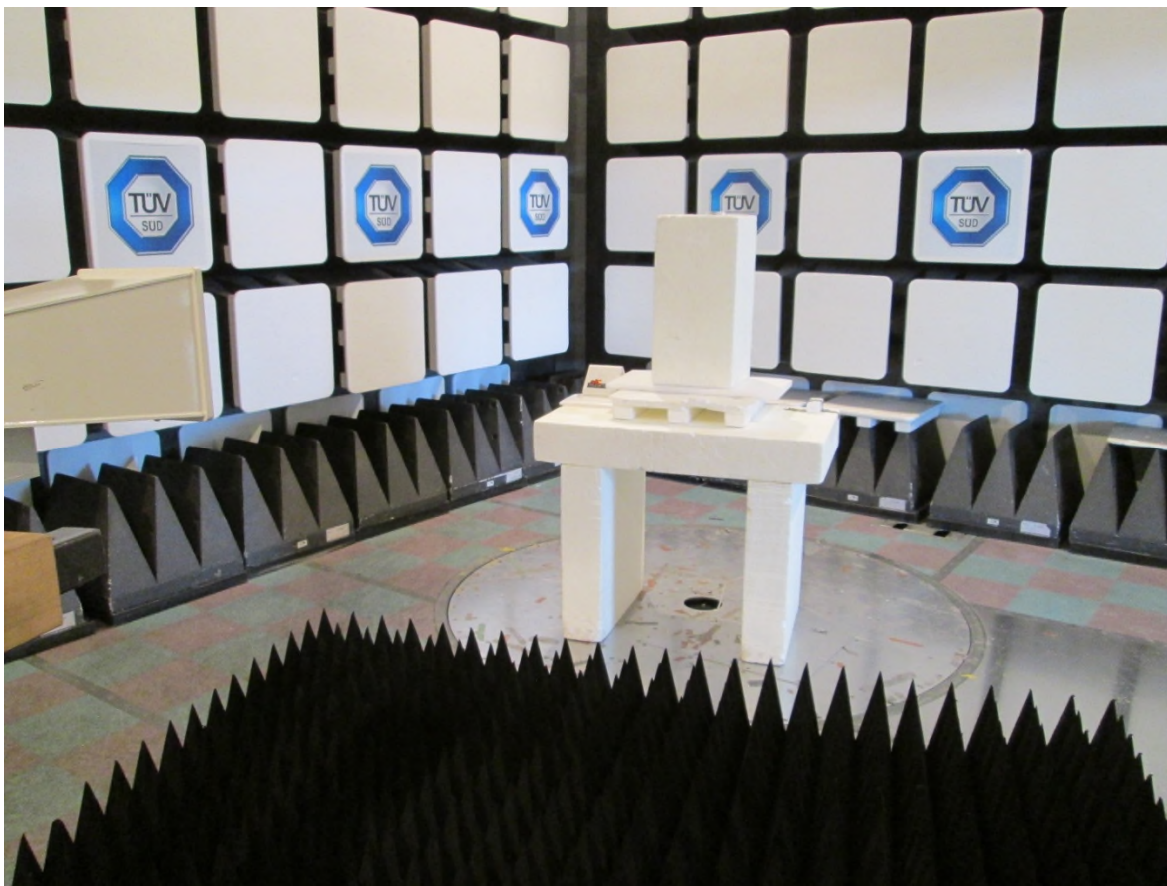
Test setup photo 2
Radiated measurements, 30 MHz – 1 GHz

Client	Square Inc.	 Canada
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	




Test setup photo 3
Radiated measurements, 1 GHz – 2 GHz

Client	Square Inc.	 Canada
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	




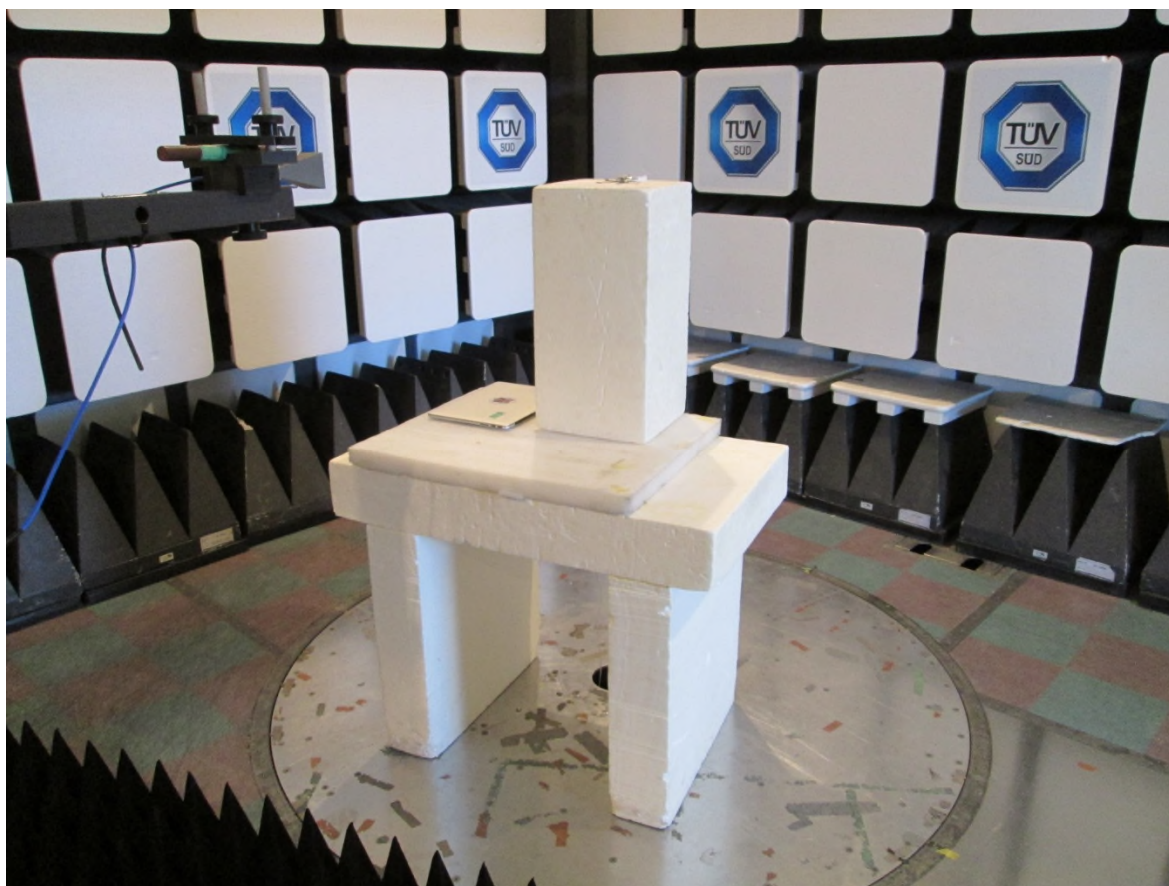
Test setup photo 4
Radiated measurements, 2 GHz – 10 GHz

Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	




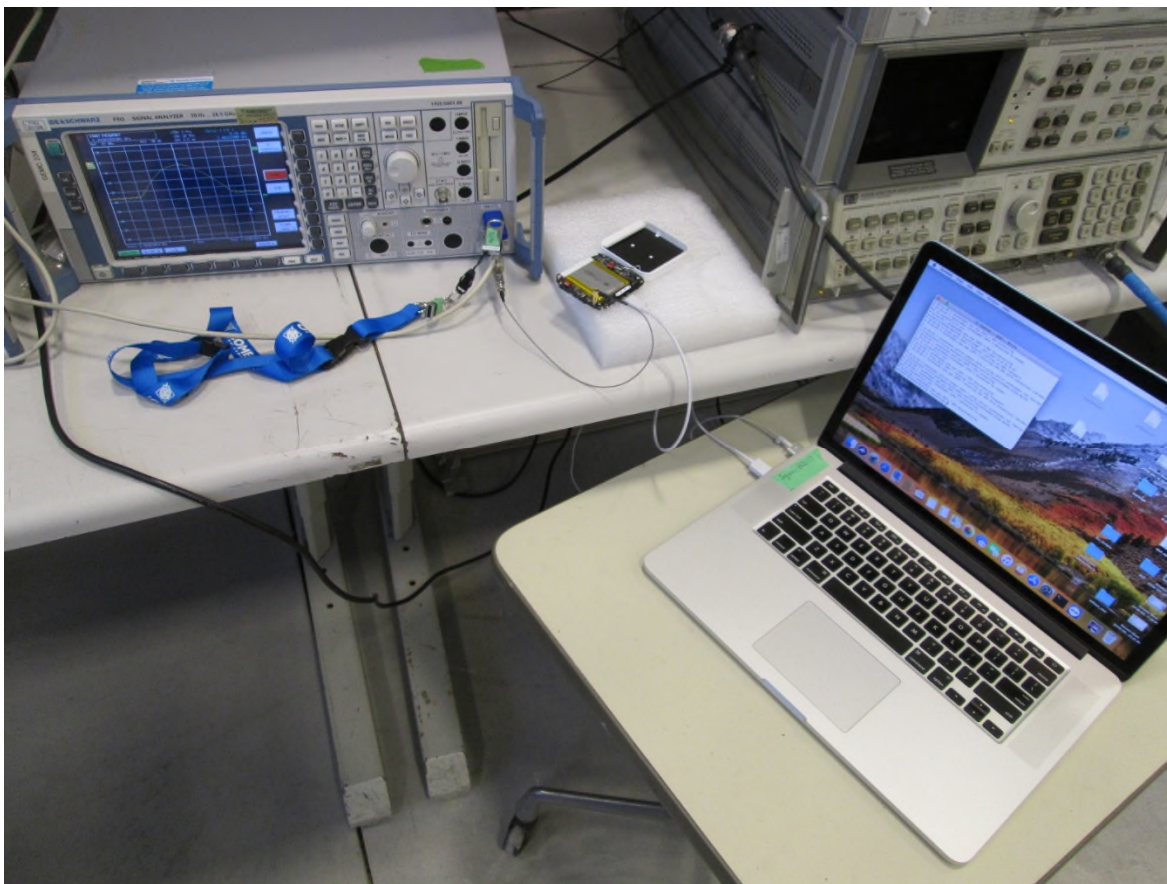
Test setup photo 5
Radiated measurements, 10 GHz – 18 GHz

Client	Square Inc.	
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	



Test setup photo 6
Radiated measurements, 18 GHz – 26.5 GHz

Client	Square Inc.	 Canada
Product	Wireless card reader model SPC1	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	



Test setup photo 7
Antenna conducted measurements