

TEST REPORT

Report Number: 103088018MPK-003

Project Number: G103088018

August 20, 2017

**Testing performed on the
K-SMART3**

Model: K-SMART3

FCC ID: WFW-KSMART3

IC: 5241A-KSMART3

to

FCC Part 15 Subpart C (15.225)

Industry Canada RSS-210 Issue 9

For

Dormakaba Electronic Access & Data - Keyscan, Inc.

Test Performed by:

Intertek

1365 Adams Court

Menlo Park, CA 94025 CANADA

Test Authorized by:

Dormakaba Electronic Access & Data - Keyscan, Inc.

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Date: August 20, 2017

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Date: August 20, 2017

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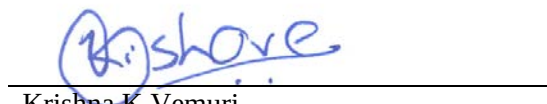
Report No. 103088018MPK-003

Equipment Under Test:	K-SMART3
Trade Name:	Dormakaba Electronic Access & Data - Keyscan, Inc.
Model Number:	K-SMART3
Serial Number:	MPK1707241613-002
FCC ID:	WFW-KSMART3
IC:	5241A-KSMART3
Applicant:	Dormakaba Electronic Access & Data - Keyscan, Inc.
Contact:	Steve Dentinger
Address:	901 Burns St. E., Whitby Ontario, Canada L1N 0E6
Country	CANADA
Tel. Number:	(888) 539-7226
Email	Steve.dentinger@dormakaba.com
Applicable Regulation:	FCC Part 15 Subpart C (15.225) Industry Canada RSS-210 Issue 9
Test Site Location:	ITS – Site 1 1365 Adams Drive Menlo Park, CA 94025
Date of Test:	July 24 to August 04, 2017

We attest to the accuracy of this report:



Minh Ly
EMC Project Engineer



Krishna K Vemuri
Engineering Team Lead

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1.0 Summary of Tests

TEST	REFERENCE FCC 15.225	REFERENCE RSS-210	RESULTS
Field Strength of Fundamental	15.225(a)	B.6	Complies
Radiated Emissions Outside the band	15.225(b), 15.225(c), 15.225(d), 15.209	B.6	Complies
Frequency Tolerance of the Carrier	15.225(e)	B.6	Complies
Line Conducted Emissions	15.207	RSS-GEN	Complies
Occupied Bandwidth	15.215	RSS-GEN	Complies
Antenna requirement	15.203	RSS-GEN	Complies ¹

¹ EUT utilizes an internal Antenna.

2.0 General Description

2.1 Product Description

Dormakaba Electronic Access & Data - Keyscan, Inc. supplied the following description of the EUT:

The K-SMART3 is a combination Smart Card Reader and BLE Mobile Access Credential Reader (hereafter referred to a “Reader”) device. The Reader is epoxy sealed, suitable for outdoor use and provided with an approved UL Style 2576, 9-conductor, 26-AWG, shielded cable for connection to a Door Access Control Unit.

The Reader is a key component of a physical security access control system, a Reader is based on dual use operating at 13.56Mhz to read RFID technology, and 2.45GHz to read a BLE enabled smartphone. In operation the Reader is capable of reading data stored on smartcard credentials via radio frequency without physical contact, also read data stored on the BLE enabled smartphone with a specialized application program and then passing the data obtained to the physical access control system. Access control systems typically manage and record the movement of individuals through a protected area, such as a locked door.

Overview of the EUT

Applicant name & address	Dormakaba Electronic Access & Data - Keyscan, Inc. 901 Burns St. E., Whitby Ontario, Canada L1n 0E6
Manufacturer & address	Dormakaba Electronic Access & Data - Keyscan, Inc. 901 Burns St. E., Whitby Ontario, Canada L1n 0E6
Contact info / Email	Steve Dentinger / Steve.dentinger@dormakaba.com
Model	K-SMART3
FCC Identifier	WFW-KSMART3
IC Identifier	5241A-KSMART3
Operating Frequency	13.56MHz
Number of Channels	1
Type of Modulation	ASK
Operating Temperature	-20°C to +50°C
Antenna Type	Internal PCB Antenna

EUT receive date: July 24, 2017
EUT receive condition: The EUT was received in good condition with no apparent damage. As declared by the Applicant it is identical to the production units.
Test start date: July 24, 2017
Test completion date: August 04, 2017

2.2 Related Submittal(s) Grants

None

2.3 Test Methodology

Both AC mains line-conducted and radiated emissions measurements were performed according to the procedures in ANSI C63.4. Radiated tests were performed at an antenna to EUT distance of 10 meters, unless stated otherwise in this test report. All other measurements were made in accordance with the procedures in part 2 of CFR 47.7, ANSI C63.10: 2013 & RSS-GEN Issue 4.

2.4 Test Facility

The radiated emission test site and conducted measurement facility used to collect the data is 10m semi-anechoic chamber located in Menlo Park, California. This test facility and site measurement data have been fully placed on file with the FCC and Industry Canada (Site # 2042L-1).

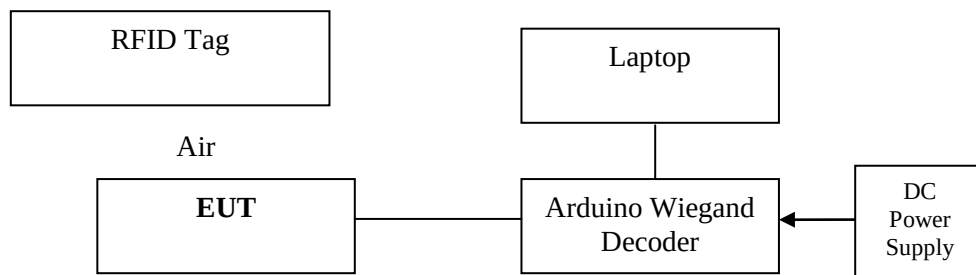
3.0 System Test Configuration

3.1 Support Equipment and description

Support Equipment			
Type	Model #	Quantity	S/N
DC Power Supply	Extech	1	D30030012
RFID Tag	Not Listed	1	N/A
Laptop	HP Elitebook	1	N/A
Arduino Wiegand Decoder	Not Listed	1	MPK1707241613-007

3.2 Block Diagram of Test Setup

The diagram shown below details the interconnection of the EUT and support equipment. For specific layout, refer to the test configuration photograph in the relevant section of this report.



S = Shielded	F = With Ferrite
U = Unshielded	m = Length in Meters

3.3 Justification

The EUT was configured to continuously transmit and looking for tags. This report covers the RFID radio only.

3.4 Software Exercise Program

The special test mode can be control via external Host Commands using Arduino 1.6.8.

3.5 Mode of Operation during test

EUT was continuously transmitting and reading tags during the tests.

3.6 Modifications required for Compliance

No modifications were installed by Intertek Testing Services during compliance testing in order to bring the product into compliance.

3.7 Additions, deviations and exclusions from standards

No additions, deviations or exclusion have been made from standard.

4.0 Measurement Results

4.1 Field Strength of Fundamental and Radiated Emissions Outside the band

4.1.1 Requirements

FCC Rules 15.225, 15.209

- a) The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter (84 dBuV) at 30 meters.
- b) Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.
- c) Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.
- d) The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in §15.209.

§15.209 Radiated emission limits; general requirements.

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

4.1.2 Procedure

Radiated Measurements Below 30 MHz

During the test the EUT is rotated and the measuring antenna angles are varied during the search for maximum signal level.

Radiated emissions are taken at ten meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance. Measurements for below 30 MHz were made at 10 meters. Data results below are corrected for distance back to 30 meters.

Radiated Measurements Above 30 MHz

During the test the EUT is rotated and the measuring antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters.

Radiated emissions are taken at ten meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance. Measurements for above 30 MHz were made at 10 meters.

Radiated emission measurements were performed from 9kHz to 1 GHz.
Analyzer resolution is:

200Hz or greater for 9kHz to 150kHz
9 kHz or greater for 150kHz to 30 MHz
120 kHz or greater for 30MHz to 1000 MHz
For those frequencies quasi-peak detector applies

Data includes of the worst-case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs and data tables of the emissions are included.

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation is as follows:

$$FS = RA + AF + CF - AG - DCF$$

Where FS = Field Strength in dB (μ V/m)

RA = Receiver Amplitude (including preamplifier) in dB (μ V)

CF = Cable Attenuation Factor in dB

AF = Antenna Factor in dB (1/m)

AG = Amplifier Gain in dB

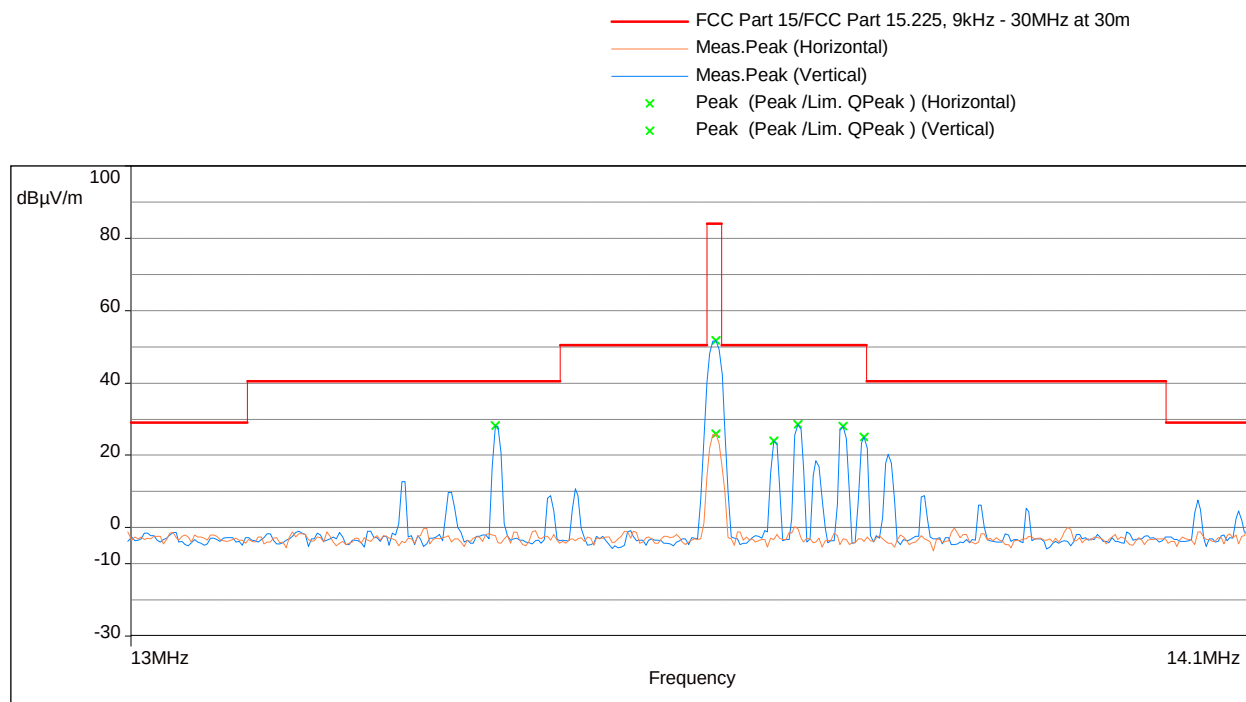
DCF = Distance Correction Factor

Note: FS was measured with loop antenna below 30MHz

4.1.3 Test Result 15.225 (a)(b)(c)

The data below shows the significant emission frequencies, the limit and the margin of compliance.

Note: Measurements were performed at parallel and perpendicular orientation of loop antenna, and vertical and horizontal orientations of EUT. The worst case data was presented below.



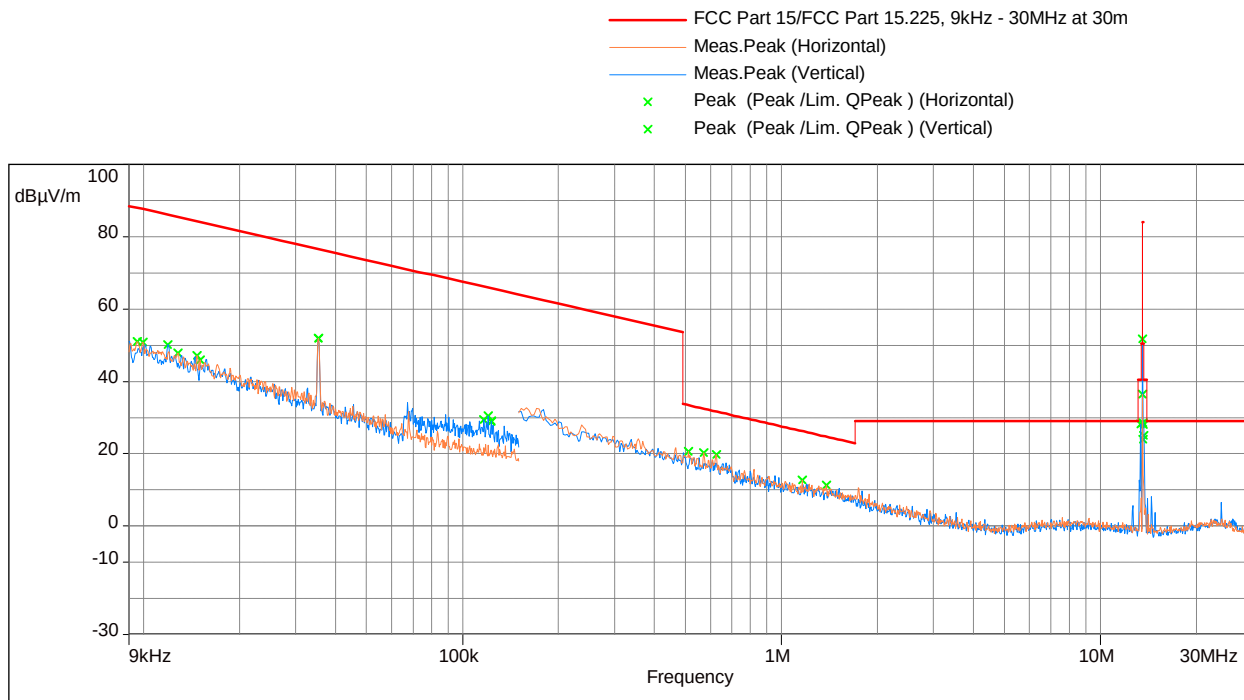
Model: ; Client: ; Comments: ; Test Date: 08/02/2017 11:04

Frequency	Peak FS@30m	Limit@30m	Margin	RA@10m	Correction
(MHz)	dB(uV/m)	dB(uV/m)	dB	dB(uV)	dB
13.56	51.7	84	-32.3	67.8	-16.1

Note: Correction = AF+CF-AG-DCF

4.1.4 Test Result 15.225 (d)

Radiated Spurious Emissions from 9 kHz to 30MHz

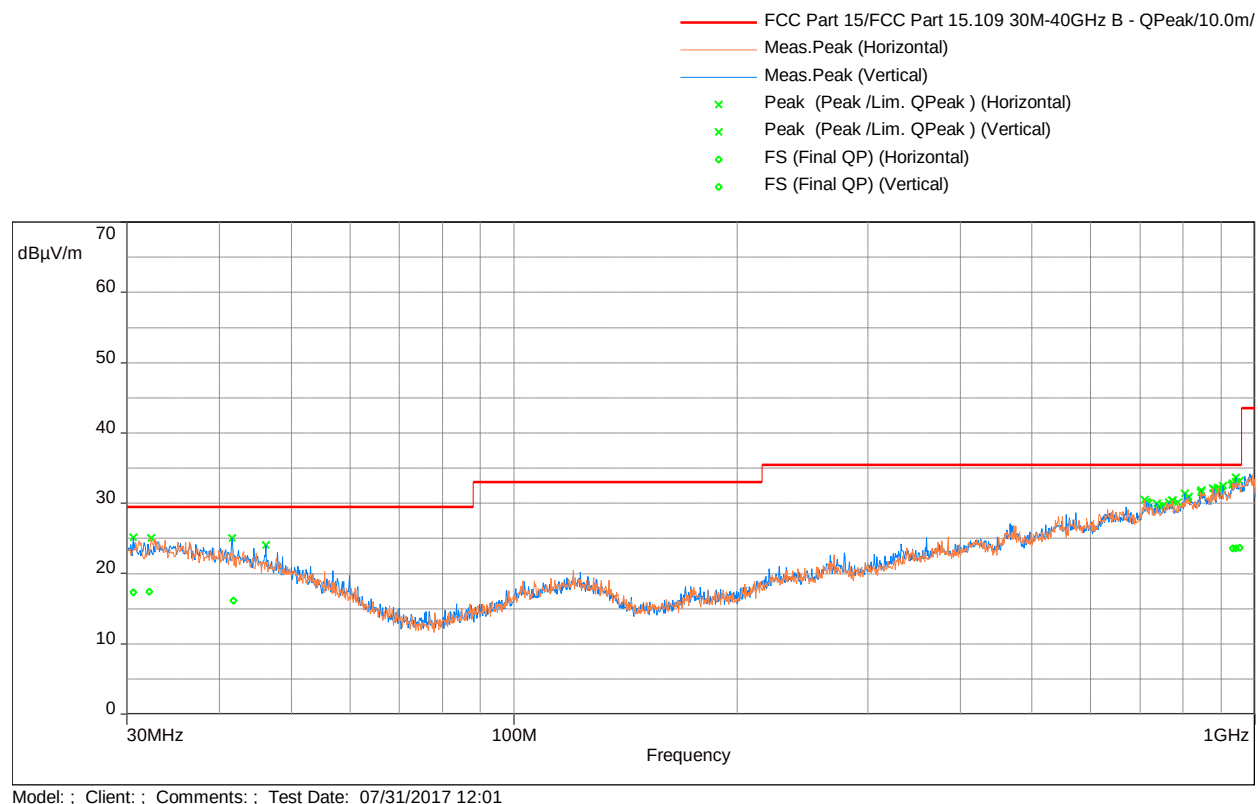


Model: ; Client: ; Comments: ; Test Date: 08/02/2017 11:04

Frequency	Peak	Limit@30m	Margin	RA@10m	Correction
(MHz)	FS @30m	dB(uV/m)	dB	dB(uV)	dB
0.035	51.8	76.6	-24.8	26.5	25.3

Note: Correction = AF+CF-AG-DCF

Radiated Spurious Emissions from 30 MHz to 1000 MHz



Freq (MHz)	FS (dB(uV/m))	Limit (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
32.145	17.4	29.5	-12.1	97.8	3.9	Horizontal	21.5	-4.2
933.806	23.5	35.5	-12.0	88.3	3.4	Horizontal	19.0	4.5
953.712	23.6	35.5	-11.9	153.3	3.5	Horizontal	18.7	4.9
30.561	17.3	29.5	-12.2	237.0	1.2	Vertical	21.3	-4.1
41.714	16.2	29.5	-13.3	162.3	3.8	Vertical	21.4	-5.2
941.446	23.6	35.5	-11.9	107.3	1.7	Vertical	18.7	4.9

Result	Complies by 11.9dB
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4.1.5 Test Configuration Photographs

The following photographs show the testing configurations used.



Electromagnetic Radiated Disturbance Setup Photograph

4.1.5 Test Configuration Photographs (Continued)



4.2 Frequency Tolerance

4.2.1 Requirement FCC 15.225 (e)

The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ of the operating frequency over a temperature variation of -20 degrees to $+50$ degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

4.2.2 Procedure

The EUT was placed in the temperature chamber. The frequency counter was connected to the transmitter output. For each temperature, the carrier frequency was recorded. In addition, the carrier frequency was recorded when the power was set to 13.8 V DC (115% of 12V DC) and to 8.5 V DC (85% of 12V DC).

4.2.3 Test Results 15.225 (e)

Nominal Frequency: 13560000 Hz

K-SMART3				
Voltage (DC)	Temperature (C)	Measured Frequency (Hz)	Deviation from Reference (Hz)	Deviation (%)
12	-20	13559885	115	0.000848
12	-10	13559967	33	0.000243
12	0	13559878	122	0.000900
12	10	13559879	121	0.000892
12	20	13559879	121	0.000892
12	30	13559911	89	0.000656
12	40	13559919	81	0.000597
12	50	13559903	97	0.000715
8.5	20	13559887	113	0.000833
13.8	20	13559887	113	0.000833

4.3 Occupied Bandwidth FCC 15.215

4.3.1 Requirements

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage.

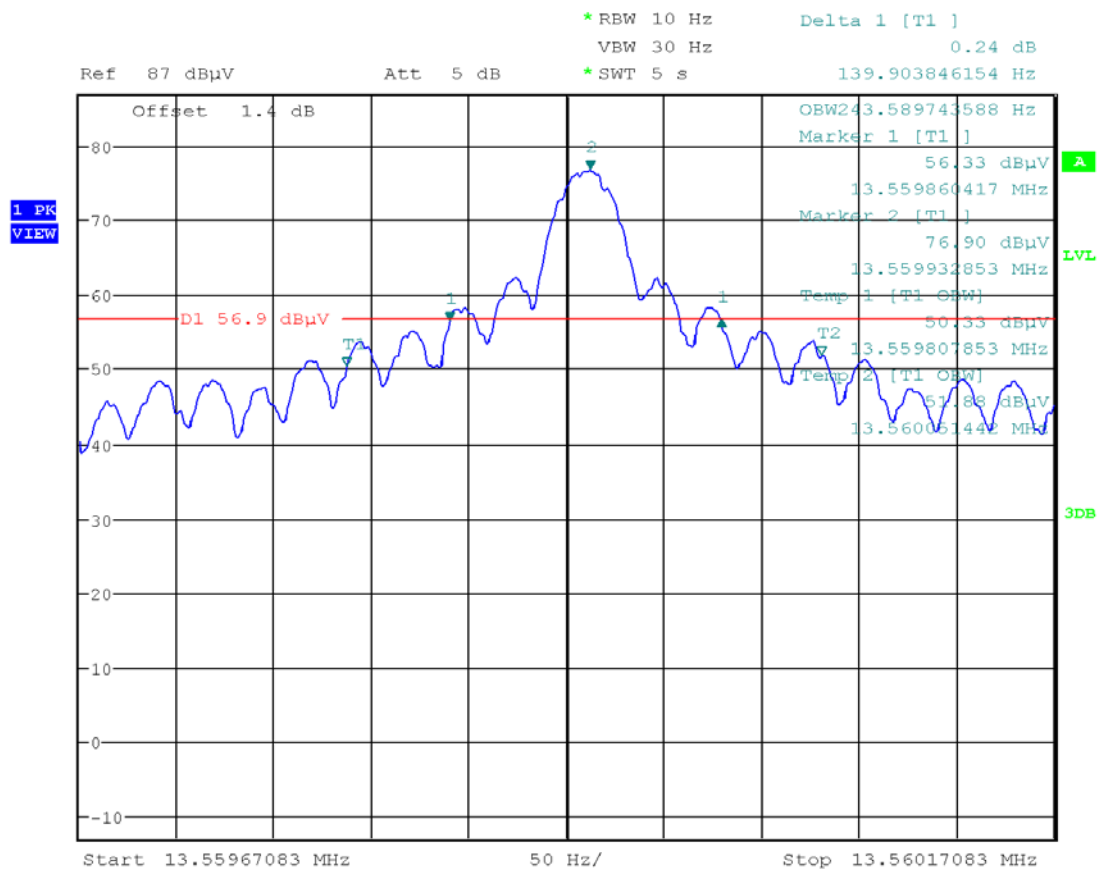
4.3.2 Procedure

The EUT was setup to transmit in normal operating condition.

Measurements were made with the loop antenna in close proximity of the EUT. Following the procedures of ANSI 63.10, the 20dB bandwidth measurements were taken. The following plots show Occupied Bandwidth.

4.3.3 Test Results

EUT	Frequency (MHz)	20-dB Channel Bandwidth (Hz)	99% Channel Bandwidth (Hz)
K-SMART3	13.56	139.9	243.6



Date: 1.AUG.2017 16:48:30

4.4 AC Line Conducted Emission FCC Rule 15.207

4.4.1 Requirement

Frequency Band MHz	Class B Limit dB(μ V)		Class A Limit dB(μ V)	
	Quasi-Peak	Average	Quasi-Peak	Average
0.15-0.50	66 to 56 *	56 to 46 *	79	66
0.50-5.00	56	46	73	60
5.00-30.00	60	50	73	60

Note: *Decreases linearly with the logarithm of the frequency. At the transition frequency the lower limit applies.

4.4.2 Procedure

Measurements are carried out using quasi-peak and average detector receivers in accordance with CISPR 16. An AMN is required to provide a defined impedance at high frequencies across the power feed at the point of measurement of terminal voltage and also to provide isolation of the circuit under test from the ambient noise on the power lines. An AMN as defined in CISPR 16 shall be used.

The EUT is located so that the distance between the boundary of the EUT and the closest surface of the AMN is 0.8m.

Where a flexible mains cord is provided by the manufacturer, this shall be 1m long or if in excess of 1m, the excess cable is folded back and forth as far as possible so as to form a bundle not exceeding 0.4m in length.

The EUT is arranged and connected with cables terminated in accordance with the product specification.

Conducted disturbance is measured between the phase lead and the reference ground, and between the neutral lead and the reference ground. Both measured values are reported.

The EUT, where intended for tabletop use, is placed on a table whose top is 0.8m above the ground plane. A vertical, metal reference plane is placed 0.4m from the EUT. The vertical metal reference-plane is at least 2m by 2m. The EUT shall be kept at least 0.8m from any other metal surface or other ground plane not being part of the EUT. The table is constructed of non-conductive materials. Its dimensions are 1m by 1.5m, but may be extended for larger EUT.

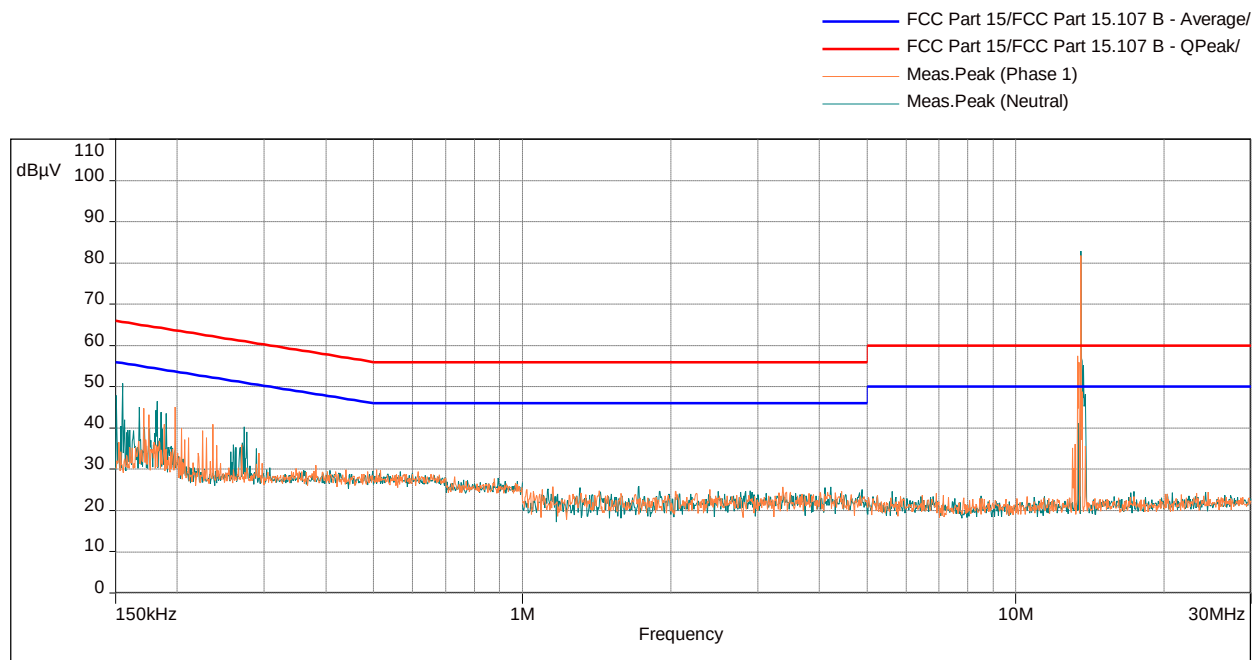
Floor standing EUT are placed on a horizontal metal ground plane and isolated from the ground plane by resting on an insulating material. The metal ground plane extends at least 0.5m beyond the boundaries of the EUT and has minimum dimensions of 2m by 2m.

EUT was placed in transmission mode then tested for conducted emissions per 15.207 to ensure the device complies with 15.207 outside the transmitter fundamental emissions band. After, the EUT antenna is removed from the EUT and only the fundamental emission band was measured to show that the fundamental emission band is in compliance with the 15.207 limits.

Equipment setup for conducted disturbance tests followed.

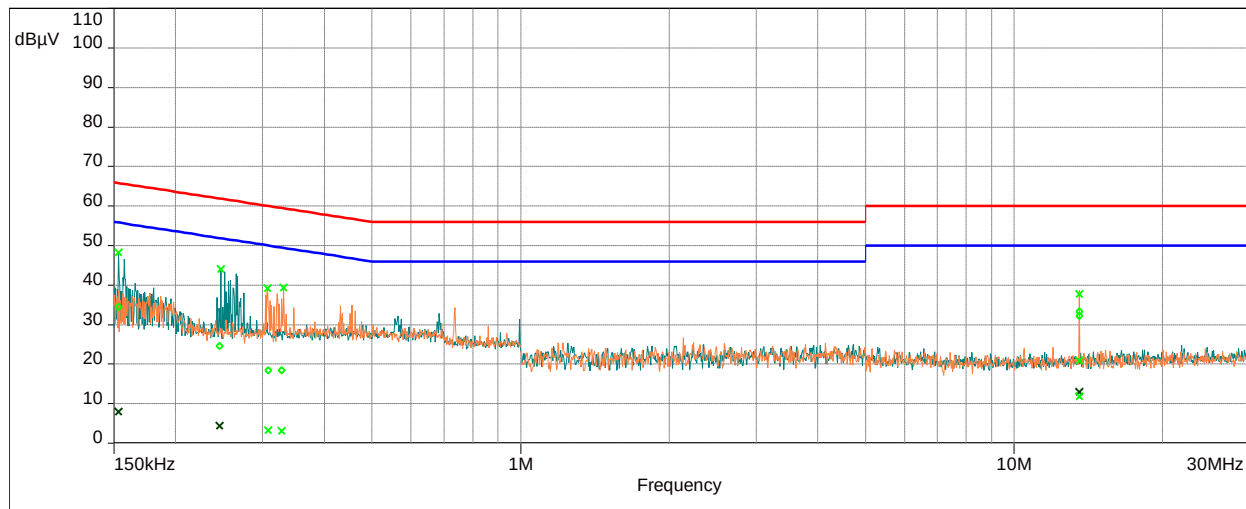
4.4.3 Test Result

AC Line Conducted Emission on Model Number: K-SMART3



Test with Antenna removed and terminated

- FCC Part 15/FCC Part 15.107 B - Average/
- FCC Part 15/FCC Part 15.107 B - QPeak/
- × Level (Manual finals) (Phase 1)
- × Level (Manual finals) (Neutral)
- Meas.Peak (Phase 1)
- Meas.Peak (Neutral)
- × Ave Level (dBuV) (Final QP and Ave) (Phase 1)
- × Ave Level (dBuV) (Final QP and Ave) (Neutral)
- ◇ QP Level (dBuV) (Final QP and Ave) (Phase 1)
- ◇ QP Level (dBuV) (Final QP and Ave) (Neutral)



Model: ; Client: ; Comments: ; Test Date: 08/02/2017 14:36

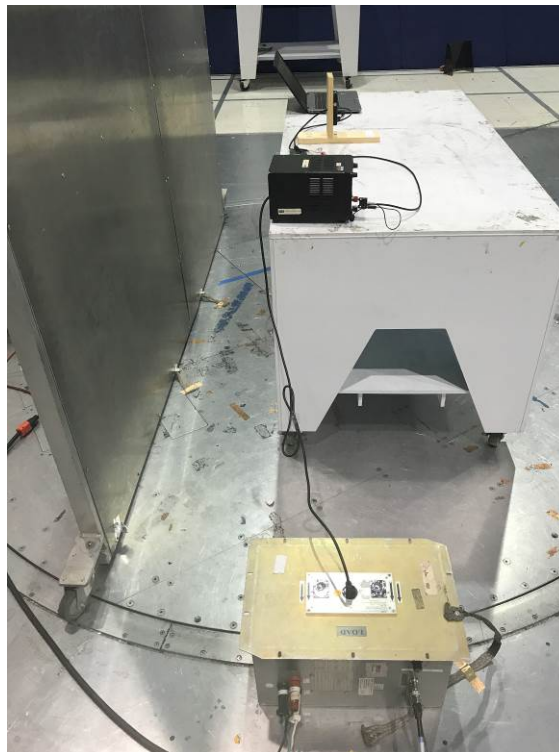
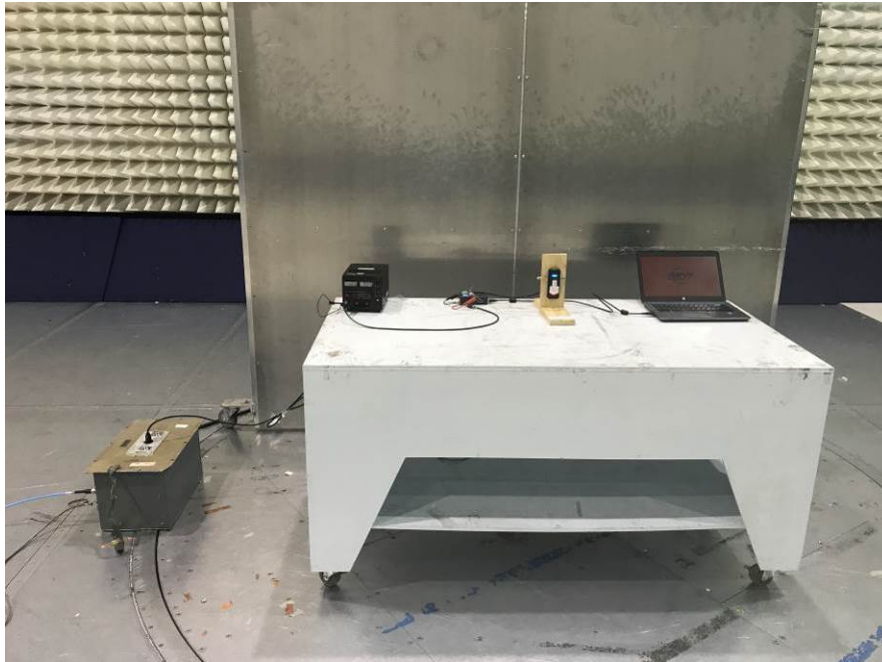
Frequency (MHz)	Ave Level (dBuV)	QP Level (dBuV)	Ave Limit (dBuV)	QP Limit (dBuV)	Ave Margin (dB)	QP Margin (dB)	Line	Correction (dB)
0.308193	3.3	18.5	50.0	60.0	-46.7	-41.5	Phase 1	11.1
0.327495	3.2	18.5	49.5	59.5	-46.4	-41.0	Phase 1	11.1
13.559923	11.9	32.3	50.0	60.0	-38.2	-27.7	Phase 1	11.7
0.153054	8.0	34.5	55.8	65.8	-47.8	-31.4	Neutral	11.0
0.245649	4.4	24.6	51.9	61.9	-47.6	-37.3	Neutral	11.1
13.559936	12.9	33.4	50.0	60.0	-37.1	-26.6	Neutral	11.7

Result

Complies by 26.6 dB

4.4.4 Test Configuration Photographs

The following photographs show the testing configurations used.



5.0 List of test equipment

Measurement equipment used for emission compliance testing utilized the equipment on the following list:

Equipment	Manufacturer	Model/Type	Asset No.	Calibration Interval	Cal Due
Passive Loop Antenna	EMCO	6512	ITS 01598	12	09/13/17
Passive Loop Antenna	Solar Electronics	7334-1	ITS 001608	12	09/12/17
Spectrum Analyzer	Rohde & Schwarz	FSP	ITS 001200	12	10/10/17
Pre-Amplifier	Sonoma Instrument	310	ITS 01493	12	09/28/17
EMI Receiver	Rohde and Schwarz	ESU	ITS 00961	12	07/10/18
BI-Log Antenna	Antenna Research	LPB-2513	ITS 00355	12	09/09/17
LISN	FCC	FCC-LISN-PA-NEMA-5-15	ITS 00551	12	09/14/17
RE Cable	TRU Corporation	TRU CORE 300	ITS 1462	12	08/24/17
RE Cable	TRU Corporation	TRU CORE 300	ITS 1465	12	08/24/17
RE Cable	TRU Corporation	TRU CORE 300	ITS 1470	12	08/24/17
Attenuator	Mini Circuits	BW-N3W5+	ITS 1315	12	10/19/17
Notch Filter	MICRO-TRONICS	BRM50702	ITS 1166	12	12/08/18
RE Cable	Megaphase	EMC1-K1K1-236	IT 1538	12	06/13/18
RE Cable	Megaphase	EMC1-K1K1-19	ITS 1482	12	08/25/17
RE Cable	Megaphase	TM40-K1K1-19	ITS 1154	12	01/26/18
Transient Limiter	COM-POWER	LIT-153A	ITS 1452	12	06/19/18

* Calibration performed by ITS prior to the test. # Calibration not required

6.0 Document History

Revision/ Job Number	Writer Initials	Reviewer Initials	Date	Change
1.0 / G103088018	ML	KV	August 20, 2017	Original document