EMC & RF Test Report

As per

RSS-210 Issue 9
&
FCC Part 15 Subpart 15.209

Unlicensed Intentional Radiators

on the

Quantam Pixel Lock

Canada

Choose certainty.
Add value.

Issued by:

TÜV SÜD Canada Inc.
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Testing produced for
dormakaba
See Appendix A for full client & EUT details.

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Certificate #2955.02

FEDERAL COMMUNICATIONS COMMISSION · USA ·
Registration # 382292

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Report Scope

This report addresses the EMC verification testing and test results of the **Quantam Pixel Lock**, and is herein referred to as EUT (Equipment Under Test). The EUT was tested for compliance against the following standards:

RSS-210 Issue 9:2016

FCC Part 15 Subpart C 15.209:2016

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.

Summary

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

EUT:	**Quantam Pixel Lock**
FCC Certification #, FCC ID:	SAP515238
Industry Canada Certification #, IC:	7078A-515238
EUT passed all tests performed	Yes
Tests conducted by	Scott Drysdale

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

Test Results Summary

Standard/Method	Description	Class/Limit	Result
FCC 15.203	Antenna Requirement	Unique	Pass See Justification
FCC 15.205 RSS-GEN (Table 6)	Restricted Bands for Intentional Operation	QuasiPeak Average	Pass See Justification
FCC 15.209 RSS-GEN (Table 4)	Spurious Radiated Emissions	QuasiPeak Average	Pass
	Fundamental	< 50mV/m	
	Harmonics	< 500uV/m	
	Spurious Occupied bandwidth	—	—
FCC 15.207 RSS-GEN (Table 3)	Power Line Conducted Emissions	QuasiPeak Average	Pass See Justifications
Overall Result			**Pass**

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. A 'PASS' / 'FAIL' grade within measurement uncertainty is marked with a '*'.

Notes, Justifications, or Deviations

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

For the Antenna requirement specified in FCC 15.203, the unit uses a PCB trace loop antenna for 13.56 MHz with less gain than 6 dBi.

For the Restricted Bands of operation, the EUT is designed to only operate at 13.56 MHz.

For the scope of this test report, the EUT was mounted in three orthogonal axis to maximize emissions. Worst case results are presented.

The EUT was tested with both the RFID on in continuous transmission. The worst case results are presented.

Power line conducted emissions was not performed as the device was battery powered with no provision for connection to AC mains.

Sample Calculation(s)

Radiated Emission Test

Margin = Limit – (Received Signal + Antenna Factor + Cable Loss – Pre-Amp Gain)
Margin = 50.5dBµV/m – (50dBµV + 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 = 73.0dBµV – (50dBµV + 10dB + 2.5dB + 0.5dB)
Margin = 10.0 dB (pass)

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
CISPR 22:2008	Information Technology Equipment - Radio Disturbance Characteristics - Limits and Methods of Measurement
FCC KDB 558074: 2016	FCC KDB 558074 Digital Transmission Systems, measurements and procedures
ICES-003 Issue 6 2016	Digital Apparatus - Spectrum Management and Telecommunications Policy Interference-Causing Equipment Standard
RSS-GEN Issue 4 2014	General Requirements and Information for the Certification of Radio Apparatus
ISO 17025:2005	General Requirements for the Competence of Testing and Calibration Laboratories

Document Revision Status

Revision 000 - Oct 29, 2018. Initial Release

Revision 001 – Mar 22, 2019. Test setup photos removed as per customer request, provided in separate exhibit to FCC.

Definitions and Acronyms

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

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

BW – Bandwidth. Unless otherwise stated, this is 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 with a primary function(s) of entry, storage, display, retrieval, transmission, processing, switching, or control, of data.

LISN – Line Impedance Stabilization Network

NCR – No Calibration Required

RF – Radio Frequency

Testing Facility

Testing for EMC on the EUT was carried out at TÜV SÜD Canada testing lab in Laval, near Montréal, Québec, Canada. The testing lab has a calibrated 3m semi-anechoic chamber which allows measurements on an 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. For ESD testing, the HCP is 1.6m x 0.8m and the VCP is 0.5m x 0.5m. The reference ground plane, when applicable, is 1.6m x 1.6m.

Calibrations and Accreditations

The 3m semi-anechoic chamber is registered with Federal Communications Commission (FCC, 382292) and Industry Canada (IC, 6844B-1). 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/IEC 17025 by A2LA with Testing Certificate #2955.02. 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.

Testing Environmental Conditions and Dates

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

Date	Test	Initials	Temperature (ºC)	Humidity (%)	Pressure (kPa)
Oct 1, 2018	Radiated Emissions	SD	20 – 24	40 – 51	98.0 – 102.0

Detailed Test Results Section

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

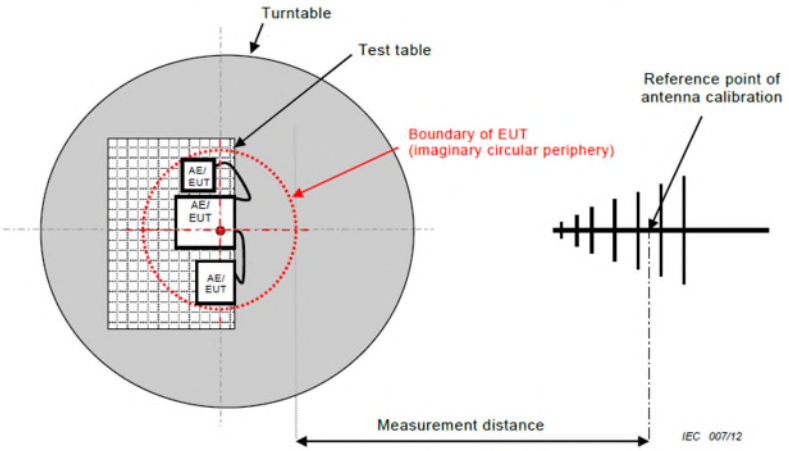
The method is as defined in Section 12.2 of FCC KDB 558074 and ANSI C63.10.

These emissions must comply with the radiated emission limits specified in Section 15.209(a).

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([3])	30 uV/m at 30m ([1])
30 MHz – 88 MHz	100 uV/m (40.0 dBuV/m) at 3m ([1])
88 MHz – 216 MHz	150 uV/m (43.5 dBuV/m) at 3m ([1])
216 MHz – 960 MHz	200 uV/m (46.0 dBuV/m) at 3m ([1])
Above 960 MHz	500 uV/m (54.0 dBuV/m) at 3m ([1])
Above 1000 MHz	500 uV/m (54 dBuV/m) at 3m ([2])

[1]Limit is with Quasi Peak detector with bandwidths as defined in CISPR-16-1-1
[2]Limit is with 1 MHz measurement bandwidth and using an Average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.
[3]Applies to 13.56 MHz intentional frequency.
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.

Typical Radiated Emissions Setup



Measurement Uncertainty

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

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.

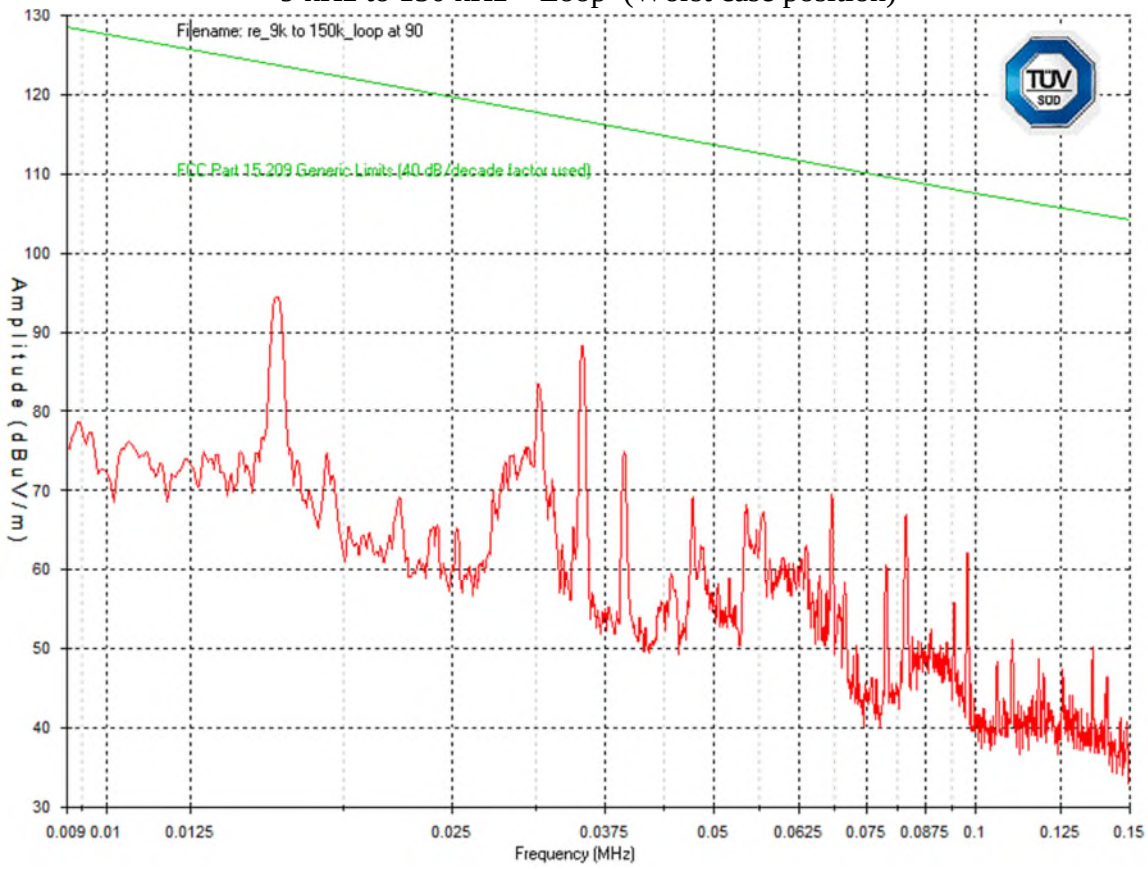
In accordance with FCC Part 15, Subpart A, Section 15.33, the device was scanned to the 10^{th} harmonic or at least 1 GHz.

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.

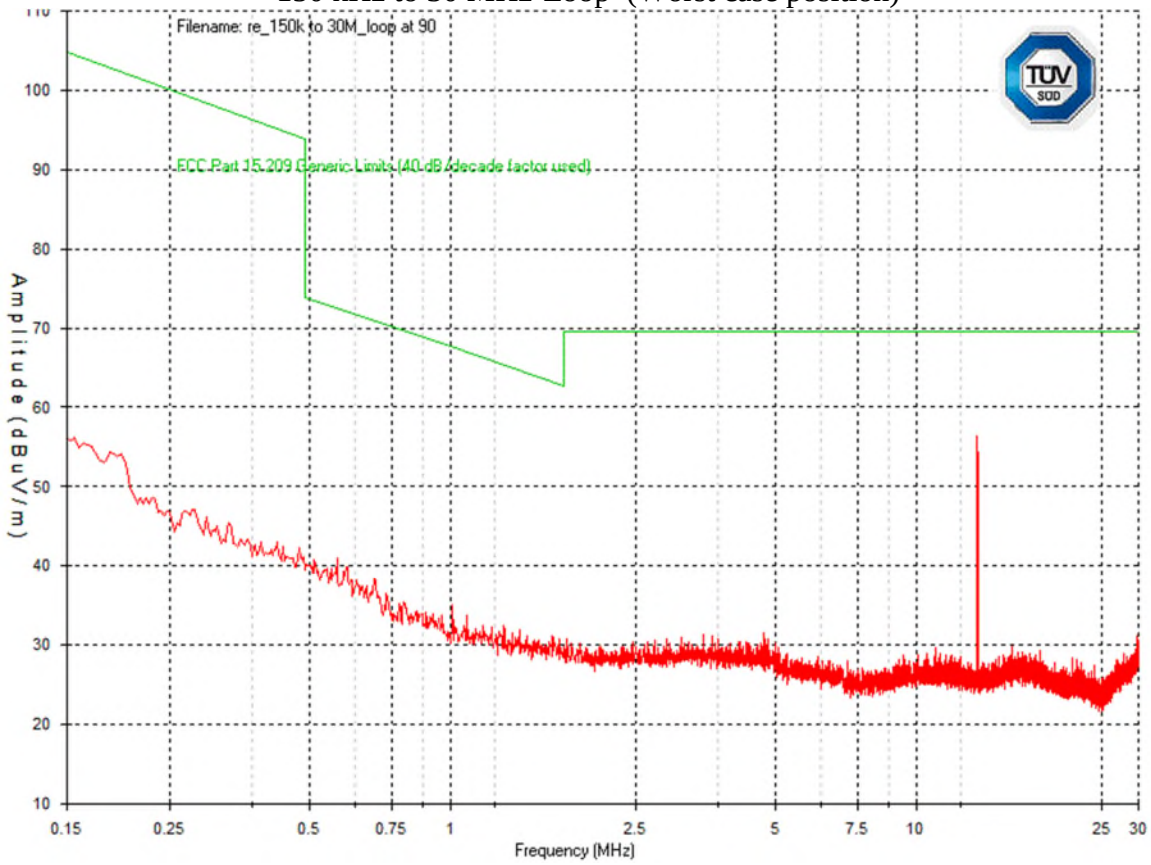
All three orthogonal axis were checked. However, the worst case graphs are presented.

. See final measurement section for all measurements.

9 kHz to 150 kHz – Loop (Worst case position)



150 kHz to 30 MHz-Loop (Worst case position)

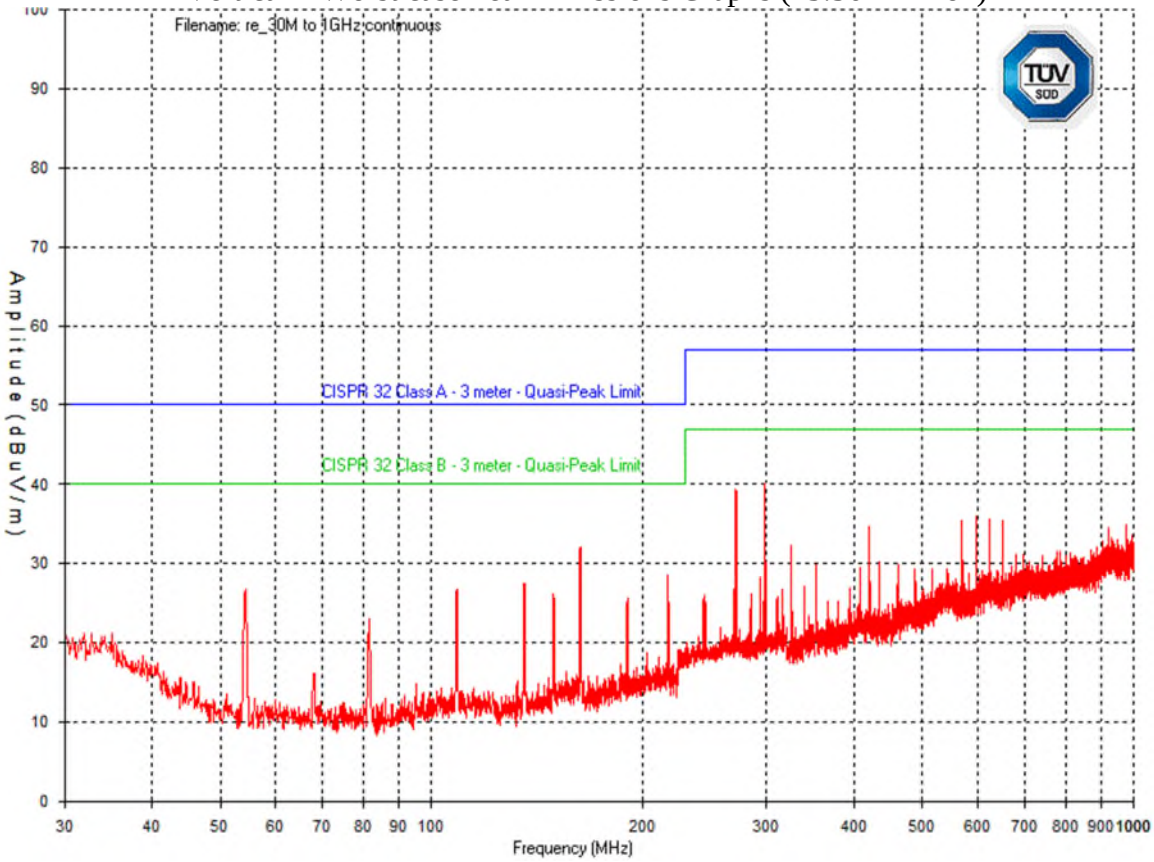


The worst case measurement as listed in the table below appeared at a Loop antenna position and a table azimuth as pictured in Appendix A.

Peak Emissions vs. Quasi Peak Limit Table – Loop@0 degree

Frequency (MHz)	Raw (dBuV)	Att. (dB)	Cable (dB)	Ant. (dB/m) +51.5	Amp (dB)	Level (dBu b/m)	Limit-3m (dBuV/m)	Margin (dB)	Pass/ Fail
13.556	46.9	3	0.4	37.6	-28.5	59.4	69.5	10.6	Pass

Vertical – Worst case Peak Emissions Graphs (13.56 MHz on)



Note: CISPR 32 limits shown above, FCC limits applied in table.

Final Measurements

Emission Reading Table – Vertical- tx ON

Frequency (MHz)	Det. mode	Raw (dBuV)	Ant. (dB/m)	Att. (dB)	Cab. (dB)	Amp (dB)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail
298.473	PEAK	54.8	13.9	3	1.7	-33.3	40.1	46	5.9	Pass
271.286	PEAK	54.4	13.6	3	1.6	-33.3	39.3	46	6.7	Pass
162.829	PEAK	51.3	9.9	3	1.2	-33.4	32	43.5	11.5	Pass
596.853	PEAK	43.1	20.8	3	2.2	-33.2	35.9	46	10.1	Pass
623.846	PEAK	41.9	21.7	3	2.3	-33.2	35.7	46	10.3	Pass
217.106	PEAK	46	11.5	3	1.5	-33.3	28.7	46	17.3	Pass

Emission Reading Table – Horizontal- tx ON

Frequency (MHz)	Det. mode	Raw (dBuV)	Ant. (dB/m)	Att. (dB)	Cab. (dB)	Amp (dB)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail
569.666	PEAK	46.1	20.2	3	2.2	-33.2	38.3	46	7.7	Pass
922.128	PEAK	39	24.6	3	2.8	-32.2	37.2	46	8.8	Pass
596.853	PEAK	44.2	20.8	3	2.2	-33.2	37	46	9	Pass
895.232	PEAK	39.8	23.7	3	2.8	-32.4	36.9	46	9.1	Pass
705.213	PEAK	40.2	22.6	3	2.4	-33	35.2	46	10.8	Pass
542.478	PEAK	40.1	21.1	3	2.1	-33.2	33.1	46	12.9	Pass

Note: Quasi-peak measurements applied above were made with a quasi-peak or peak detector with the device continuously transmitting data. These measurements do not apply a duty cycle correction factor to the peak data to correct for the average measurement.

Emission Reading Table – Vertical- tx OFF

Frequency (MHz)	Det. mode	Raw (dBuV)	Ant. (dB/m)	Att. (dB)	Cab. (dB)	Amp (dB)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail
82.671	Q.P	40.7	7.7	3	0.9	-28.5	23.8	40	16.2	Pass
56.869	PEAK	53.9	7.2	3	0.8	-28.5	36.4	40	3.6	Pass
875.549	PEAK	38.9	22.9	3	2.7	-28.4	39.1	46	6.9	Pass
30.194	PEAK	36	15.7	3	0.5	-28.5	26.7	40	13.3	Pass
46.684	PEAK	40.7	8	3	0.7	-28.5	23.9	40	16.1	Pass
305.48	PEAK	34.9	14	3	1.7	-28.6	25	46	21	Pass

Emission Reading Table – Horizontal- tx OFF

Frequency (MHz)	Det. mode	Raw (dBuV)	Ant. (dB/m)	Att. (dB)	Cab. (dB)	Amp (dB)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail
875.743	PEAK	40	23.1	3	2.7	-28.4	40.4	46	7.1	Pass
81.507	PEAK	47.8	8	3	0.9	-28.5	31.2	40	9.3	Pass
189.468	PEAK	48	9.9	3	1.3	-28.5	33.7	43.5	6.8	Pass
30.97	PEAK	35.8	16.9	3	0.6	-28.5	27.8	40	12.7	Pass
57.742	PEAK	40	6.8	3	0.8	-28.5	22.1	40	18.4	Pass
136.409	PEAK	41.1	8.7	3	1.1	-28.5	25.4	43.5	15.1	Pass

Note: Quasi-peak measurements applied above were made with a quasi-peak or peak detector with the device continuously transmitting data. These measurements do not apply a duty cycle correction factor to the peak data to correct for the average measurement.

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	ESU 40	Rhode & Schwarz	April 20, 2017	April 20, 2019	4092
Pre-Amp	LNA-1450	RF Bay Inc.	July 7, 2017	July 7, 2019	4089
Loop Antenna	EM 6879	Electro-Metrics	April 19, 2017	April 19, 2019	4040
Antenna bilog	3142-E	ETS	2016-11-16	2018-11-16	4002
RF Cable 10m	LMR-400-10M-50OHM-MN-MN	LexTec	NCR	NCR	4025
Emissions Software	0.1.94	Global EMC	NCR	NCR	GEMC 58
Horn Antenna	EM-6960	Electro-Metrics	5/3/2017	5/3/2019	4062

Occupied Bandwidth

Purpose
The purpose of this test is to measure the bandwidth occupied.

Limits
No limit applies for 15.209.

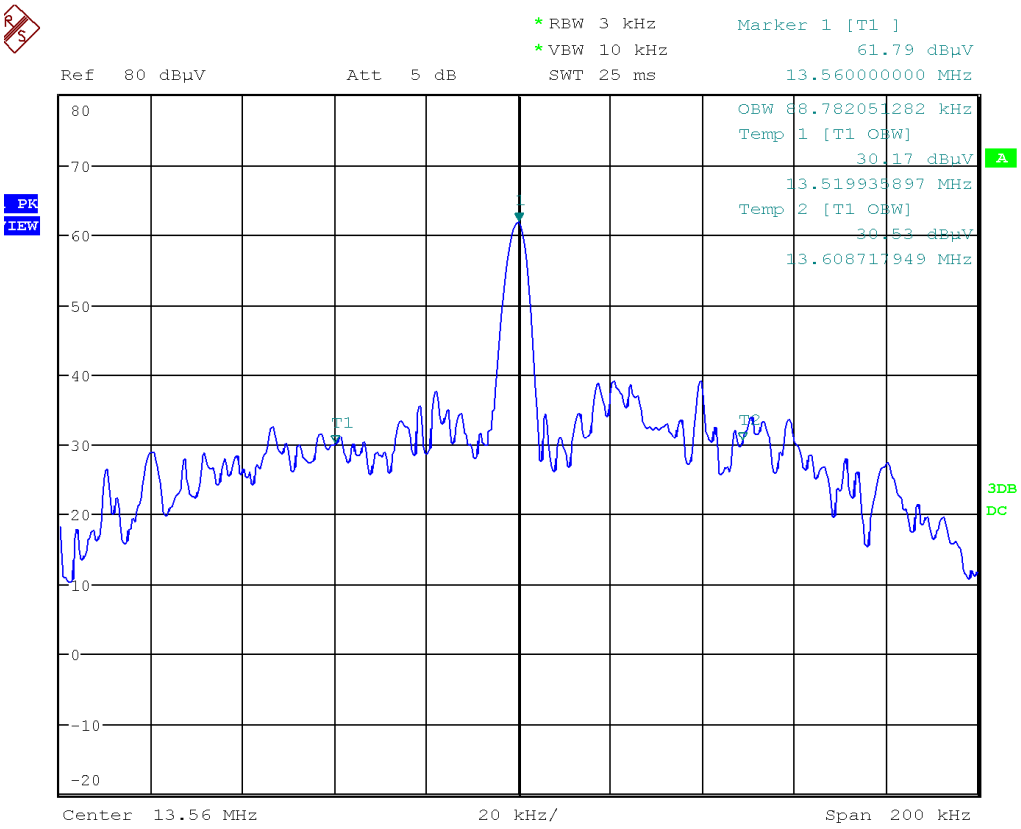
Method
For the 20 dB or occupied BW, FCC KDB 558074, Section 2.0 references ANSI C63.10 for occupied bandwidth. ANSI C63.10 Section 6.9.1 was used for occupied bandwidth.

Results
For information purposes, the 99% occupied BW was measured to be:

Mod			
Occupied BW (MHz)	88.7 kHz		

Graph(s)
The graphs shown below shows the max hold on the spectrum analyzer and the highest resolution bandwidth that is sufficiently low to exhibit the occupied bandwidth of a channel during operation of the EUT. The worst case/representative bandwidth is presented of all low, middle and high channel. This measurement is a peak measurement. Max hold is performed for a duration of not less than 1 minute.

Occupied Bandwidth



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Emissions Software	0.1.94	Global EMC	NCR	NCR	GEMC 58
Horn Antenna	EM-6960	Electro-Metrics	5/3/2017	5/3/2019	4062
Pre-Amp 1 – 26.5 GHz	HP 8449B	HP	Oct 12, 2016	Oct 12, 2018	GEMC 6351
Horn Antenna 18 – 26.5 GHz	SAS-572	A.H. Systems	Oct 11, 2016	Oct 11, 2018	GEMC 6371

Appendix A – EUT Summary

For further details for filing purposes, refer to filing package.

General EUT Description

Client Details	
Organization / Address	Dormakaba Canada Inc 7301 Decarie Blvd H4P 2G7, Montreal, Canada
EUT (Equipment Under Test) Details	
EUT Name (for report title)	Quantam Pixel Lock
EUT is powered using	DC from host
Input voltage range(s) (V)	5VDC
Frequency range(s) (Hz)	NA
Rated input current (A)	500mA
Nominal power consumption (W)	2.5W
Number of power supplies in EUT	0
Transmits RF energy? (describe)	Yes RFID (13.56 MHz)
Basic EUT functionality description	RFID (13.56 MHz)
Modes of operation	
Customer to setup EUT on site?	Yes
I/O cable description Specify length and type	N/A
Peripherals required to exercise EUT Ex. Signal generator	

Note the EUT is considered to have been received the date of the commencement of the first test, unless otherwise stated. For a close-up picture of the EUT, see 'Appendix B – EUT & Test Setup Photographs'.Note the EUT is considered to have been received the date of the commencement of the first test, unless otherwise stated. For a close-up picture of the EUT, see 'Appendix B – EUT & Test Setup Photographs'.

Appendix B – EUT and Test Setup Photos

Note: For EUT and test setup photos, refer to the photo exhibit which has been separated from this test report.