EMC Test Report

Project Number:	**4645918**	**Proposal:**	**10559 Rev 1**
Report Number:	**4645918EMC02**	**Revision Level:**	**2**
Client:	**LABORIE Medical Technologies, ULC**		

Equipment Under Test:	**NXT T-DOC PIM**
Model:	**PIX2211**
FCC ID:	**2AXRJ-TDOC3**
IC ID:	**20484-TDOC3**

Applicable Standards:	**FCC Part 15 Subpart C, §15.225**
	RSS-210, Issue 10, December 2019
	ANSI C63.10: 2013
	RSS-GEN, Issue 5, March 2019

Report issued on:	**18 January 2021**
Test Result:	**Compliant**

Prepared by: _____
Jeremy Pickens, RF Lab Manager

Reviewed by: _____
David Schramm, Operations Manager

Remarks: This report details the results of the testing carried out on one sample; the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

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1 Summary of Test Results

Test Description	Test Specification		Test Result
	FCC	ISED	
Bandwidth	15.215(c)	RSS-GEN 6.7	Reported
Field Strength of the Fundamental	15.225(a)	RSS-210 B.6(a)(i)	Compliant
Radiated Spurious Emissions / Restricted Bands	15.35(b),15.209, 15.215(b)	RSS-GEN S6.13 RSS-GEN S8.10	Compliant
Antenna Requirement	15.203	RSS-GEN S8.3	Compliant (1)
Frequency Stability	15.225(e)	RSS-210 B.6(b)	Compliant
AC Powerline Conducted Emission	15.207	RSS-GEN S8.8	Compliant

(1) The PIM antenna is an integral loop antenna.

1.1 *Modifications Required to Compliance*

None

2 General Information

2.1 *Client Information*

Name:	LABORIE Medical Technologies, ULC
Address:	6415 Northwest Drive, Unit 11
City, State, Zip, Country:	Mississauga, ON, Canada L4V1X1

2.2 *Test Laboratory*

Name:	SGS North America, Inc.
Address:	620 Old Peachtree Road NW, Suite 100
City, State, Zip, Country:	Suwanee, GA 30024, USA
CAB Identifier:	US0186

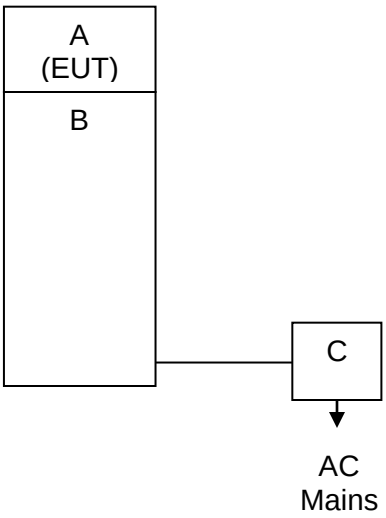
2.3 *General Information of EUT*

Type of Product:	NXT T-DOC PIM
Model:	PIX2211
Serial Number:	000081
RFID Frequency Range:	13.56 MHz
Data Modes:	RFID
Antenna(s):	Integral Loop (x4)
Rated Voltage:	4.5Vdc, (Provided by ROAM)
Sample Received Date:	07 July 2020
Dates of testing:	16 – 24 July 2020

2.4 *Operating Modes and Conditions*

The PIM was installed on a ROAM Device for operation. The ROAM device powering the PIM was loaded with a special firmware release (1.1.43.1) to increase the RFID duty cycle for facilitating measurements. Once powered, the transmission was initiated using a support laptop utilizing Synergy software. The software was modified (Build 1.2.0) to allow usage of the custom ROAM firmware. Once the “study” was started, the RFID began actively transmitting at the increased duty cycle. The USB connection between the ROAM and laptop was then replaced with an AC/DC power supply. There were no options available for adjusting the RFID amplitude.

2.5 *EUT Connection Block Diagram*



2.6 *System Configurations*

Device reference	Manufacturer	Description	Model Number	Serial Number
A	Laborie	NXT T-DOC PIM	PIX2211	000081
B	Laborie	ROAM NXT	ROX2001	0078
C	SL Power Electronics	Medical Power Supply	ME10A0500B02	Not Labeled

3 Occupied Bandwidth

3.1 *Test Result*

Test Description	Basic Standards	Test Result
99% Bandwidth	RSS-GEN 6.7	Reported
20dB Bandwidth	15.215(c)	Compliant

3.2 *Test Method*

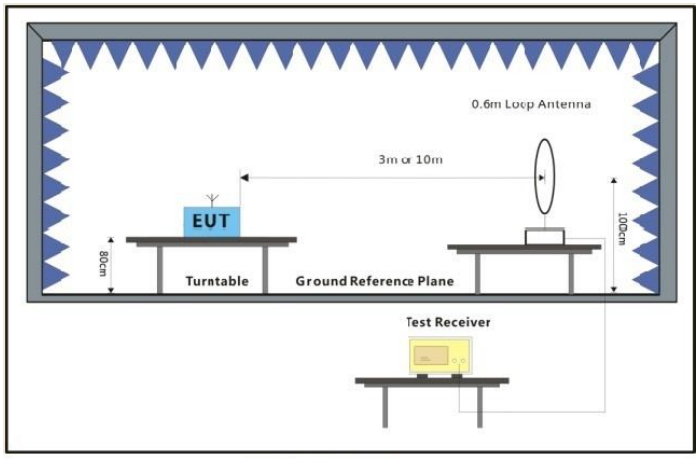
The 99% occupied bandwidth or 20dB down measurement function of the spectrum analyzer was employed.

3.3 *Test Site*

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 21.4 °C
Relative Humidity: 49.7 %
Atmospheric Pressure: 98.6 kPa



Below 30MHz

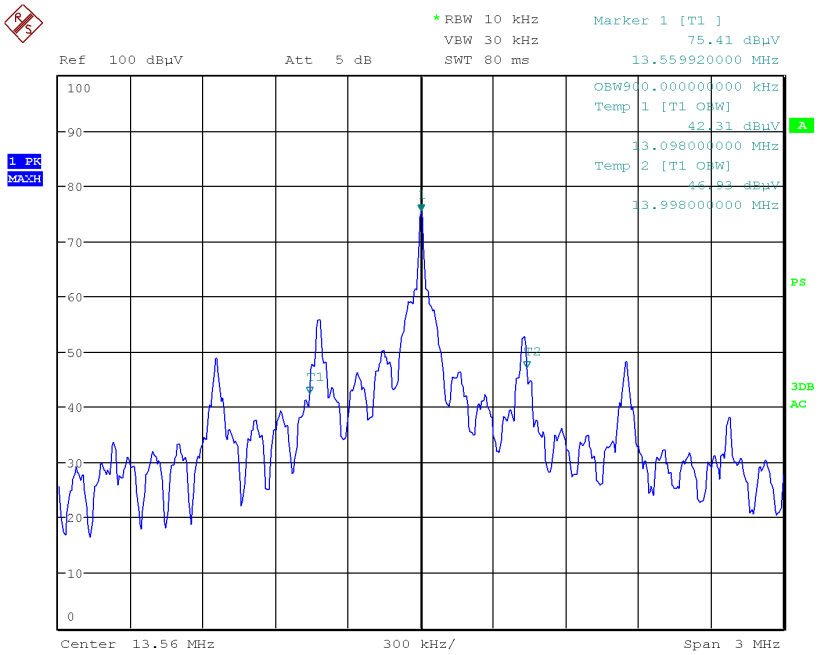
3.4 *Test Equipment*

Test End Date: 22-Jul-2020 Tester: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	7-May-2021

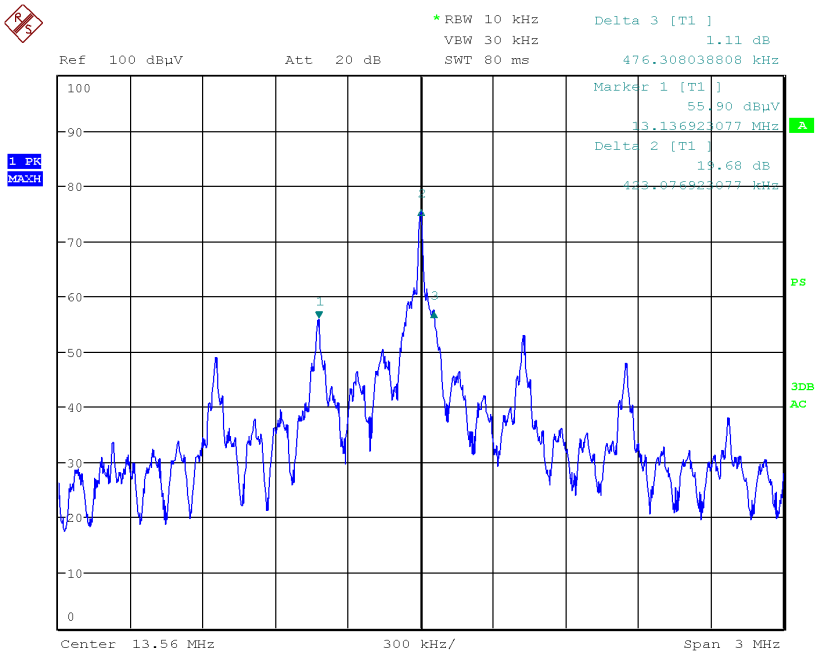
Note: The equipment calibration period is 2 years.

3.5 *Test Data*



Date: 22.JUL.2020 13:18:21

99% Occupied Bandwidth = 900.00kHz



Date: 22.JUL.2020 13:23:14

20dB Bandwidth = 476.31kHz (This falls entirely within the designated frequency band 13.110-14.010MHz)

4 Field Strength of the Fundamental

4.1 *Test Result*

Test Description	Basic Standards	Test Result
Radiated Emissions	FCC Part 15, Subpart C RSS-210 ANSI C63.10:2013	Compliant

4.2 *Test Method*

For measuring the fundamental, the receiver's resolution bandwidth was set to 9kHz. A loop antenna was employed, and peak scans were taken with the loop open towards the EUT (Co-Axial) and with the loop in-line with the EUT (Co-Planar). The antenna height was fixed at 1 m and the EUT was rotated 360° to find the maximum emitting point. The radiated measurements were recorded and compared to the limits indicated in the table below.

Radiated emissions limits

Frequency Range (MHz)	Limits (µV/m) Quasi-Peak or Average	Measurement Distance (m)
13.110 – 13.410	106	30
13.410 – 13.553	334	30
13.553 – 13.567	15,848	30
13.567 – 13.710	334	30
13.710 – 14.010	106	30

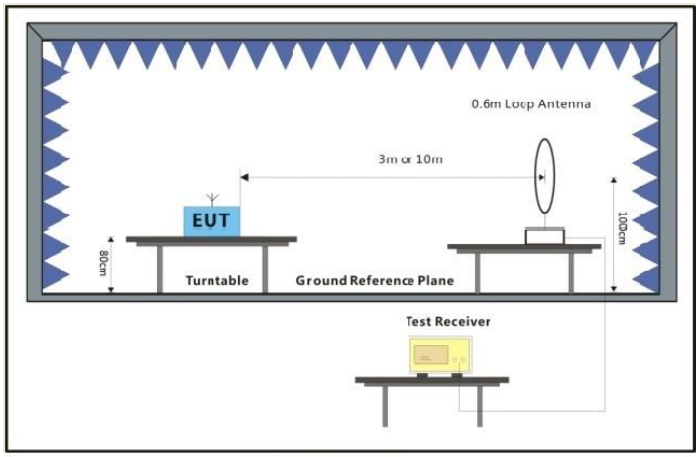
Note: Limits were converted to dBµV/m at a distance of 3m using a 40dB/decade correction per §15.31(f)(2)

Example: at 13.56MHz, the limit is expressed as 15,848µV/m at 30m
20*log (15,848) = 84dBµV/m
30 to 3 meters is a single decade, so 84 + 40 = 124dBµV/m

4.3 *Test Site*

10m Absorber Lined Shielded Enclosure (ALSE), Suwanee, GA

Temperature: 21.4 °C
Relative Humidity: 49.7 %
Atmospheric Pressure: 98.6 kPa



Below 30MHz

4.4 *Test Equipment*

Test End Date: 22-Jul-2020 Tester: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
RF Cable Nm to Nm, 0.01-18GHz	90-195-276	TELEDYNE STORM MICROWAVE	20113	2-Mar-2021
RF Cable Nm to Nm, 0.01-18GHz	90-195-118	TELEDYNE STORM MICROWAVE	20126	2-Mar-2021
RF CABLE	SF106	HUBER & SUHNER	B079713	7-Sep-2020
ANTENNA, LOOP, ACTIVE	6502	ETS Lindgren	B085752	15-Aug-2020
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	7-May-2021

Note: The equipment calibration period is 1 year.

Software:
“RSE 9k - 30M Red Loop 200117” TILE! profile dated 01 January 2020

4.5 *Test Data*

Frequency MHz	Raw QP (dBuV)	Azimuth (degrees)	Height (cm)	AF (dB)	CL (dB)	QP Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna (CA/CP)	DUT Orientation
13.56	33.2	0.0	100.0	10.7	0.3	44.2	124.0	-79.8	CA	X
13.56	32.4	260.0	100.0	10.7	0.3	43.4	124.0	-80.6	CA	Y
13.56	33.9	0.0	100.0	10.7	0.3	44.9	124.0	-79.1	CA	Z
13.56	31.8	80.0	100.0	10.7	0.3	42.8	124.0	-81.2	CP	X
13.56	32.0	10.0	100.0	10.7	0.3	43.0	124.0	-81.0	CP	Y
13.56	32.6	70.0	100.0	10.7	0.3	43.6	124.0	-80.4	CP	Z

5 Radiated Emissions

5.1 *Test Result*

Test Description	Basic Standards	Test Result
Radiated Emissions	FCC Part 15, Subpart C ANSI C63.4:2014	Compliant

5.2 *Test Method*

Exploratory scans were performed over the frequency range as indicated in the tables below using the max hold function and incorporating a Peak detector and using TILE! software. The final test data was measured using a Quasi-Peak detector below 1GHz and a Peak and Average detector above 1GHz. The receiver's resolution bandwidth was set to 1kHz for measurements taken below 150kHz, 9kHz for in the 150kHz to 30MHz range, 120 kHz in the 30MHz to 1GHz frequency range, and 1MHz for measurements of 1GHz and higher. For testing below 30MHz, a loop antenna was employed, and peak scans were taken with the loop open towards the EUT (Co-Axial) and with the loop in-line with the EUT (Co-Planar). Above 30MHz, a biconilog antenna was used and measurements were made with the antenna positioned in both the horizontal and vertical planes of polarization. The antenna height was varied from 1 m to 4 m and the EUT was rotated 360° to find the maximum emitting point for each frequency. The radiated measurements were recorded and compared to the limits indicated in the table below.

Radiated emissions limits

Frequency Range (MHz)	Limits (µV/m) Quasi-Peak or Average	Measurement Distance (m)
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

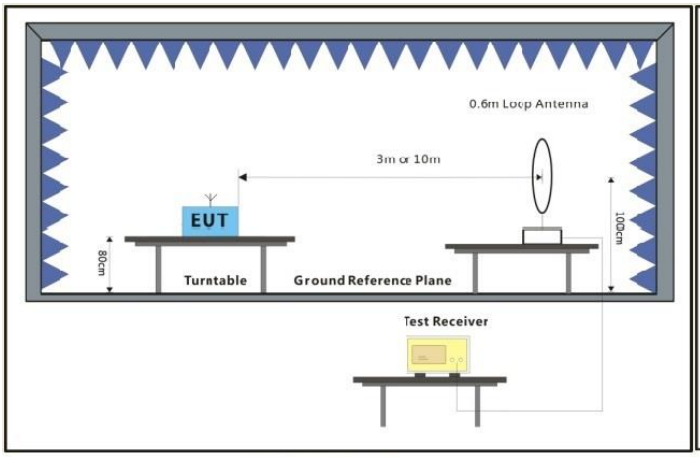
Note: Limits were converted to dBµV/m using the equation 20*LOG(x). Additionally, for measurements below 30MHz, the limits were adjusted to a distance of 3m using a 40dB/decade correction per §15.31(f)(2)

Example: at 20MHz, the limit is expressed as 30µV/m at 30m
20*log(30) = 29.5dBµV/m
30 to 3 meters is a single decade, so 29.5 + 40 = 69.5dBµV/m

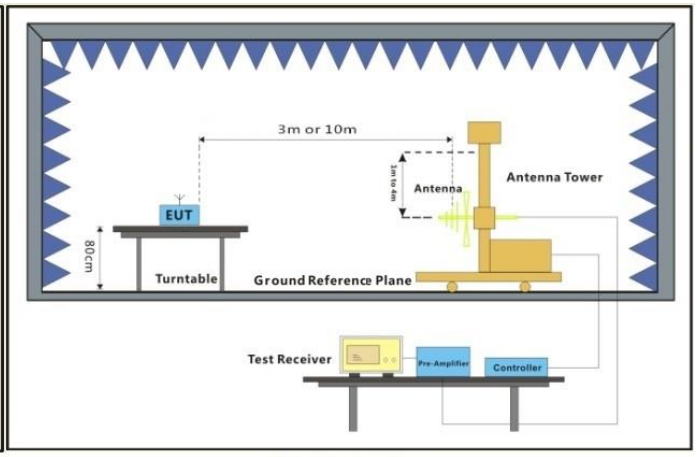
5.3 *Test Site*

10m Absorber Lined Shielded Enclosure (ALSE), Suwanee, GA

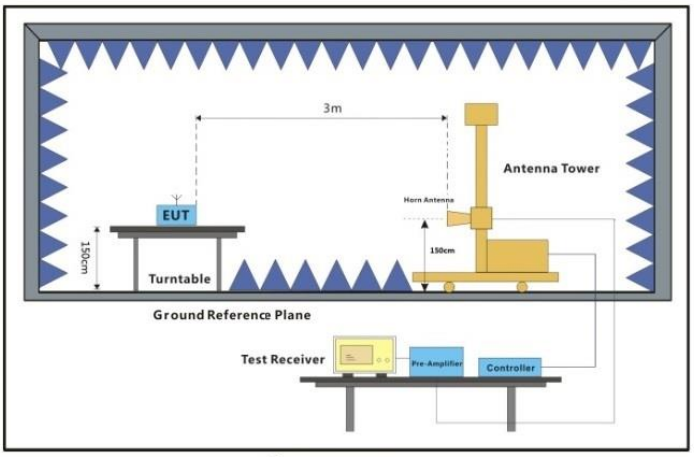
Temperature:	21.4 °C
Relative Humidity:	49.7 %
Atmospheric Pressure:	98.6 kPa



Below 30MHz



30MHz-1GHz



Above 1GHz

5.4 *Test Equipment*

Test End Date: 22-Jul-2020 Tester: JOP

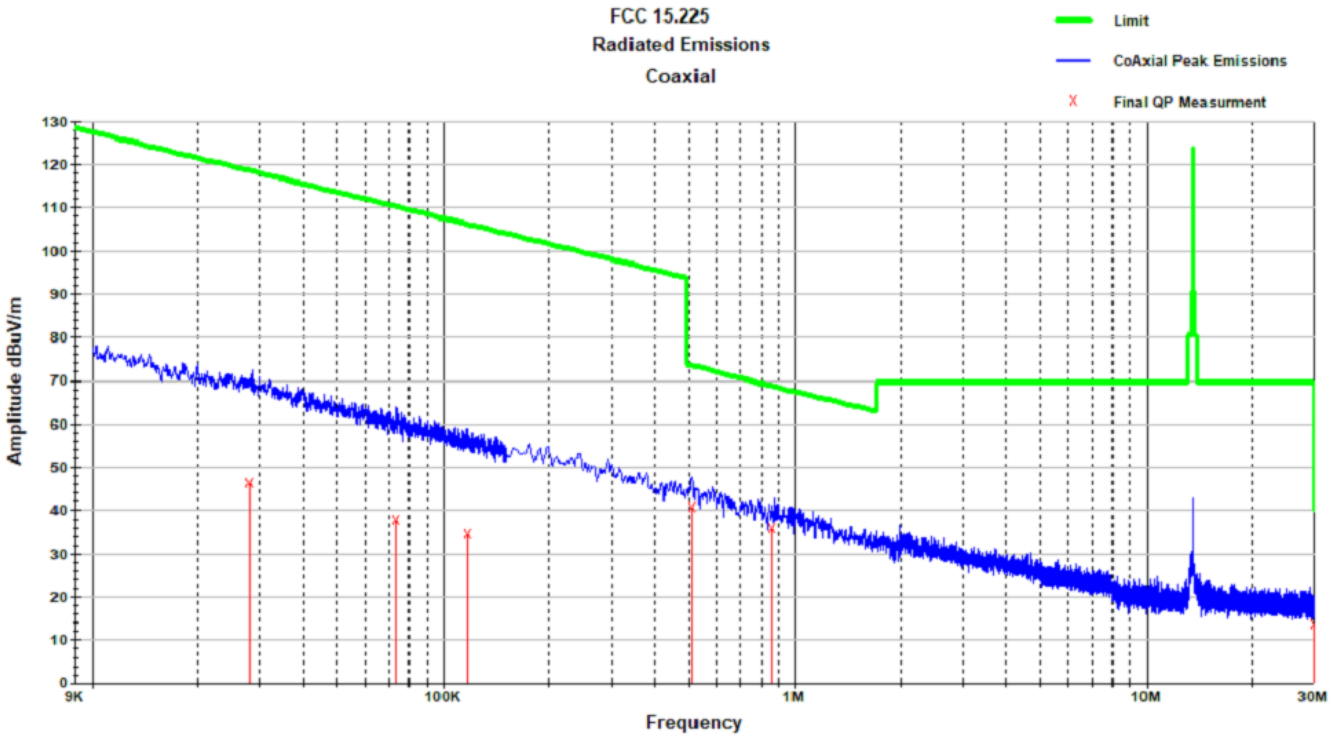
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
RF Cable Nm to Nm, 0.01-18GHz	90-195-276	TELEDYNE STORM MICROWAVE	20113	2-Mar-2021
RF Cable Nm to Nm, 0.01-18GHz	90-195-118	TELEDYNE STORM MICROWAVE	20126	2-Mar-2021
RF CABLE	SF106	HUBER & SUHNER	B079713	7-Sep-2020
RF CABLE	104PE	HUBER & SUHNER	B079793	5-Sep-2020
LOW NOISE AMPLIFIER	ZKL-2+	Mini-Circuits	B079800	16-Sep-2020
ANTENNA, LOOP, ACTIVE	6502	ETS Lindgren	B085752	15-Aug-2020
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	7-May-2021

Note: The equipment calibration period is 1 year.

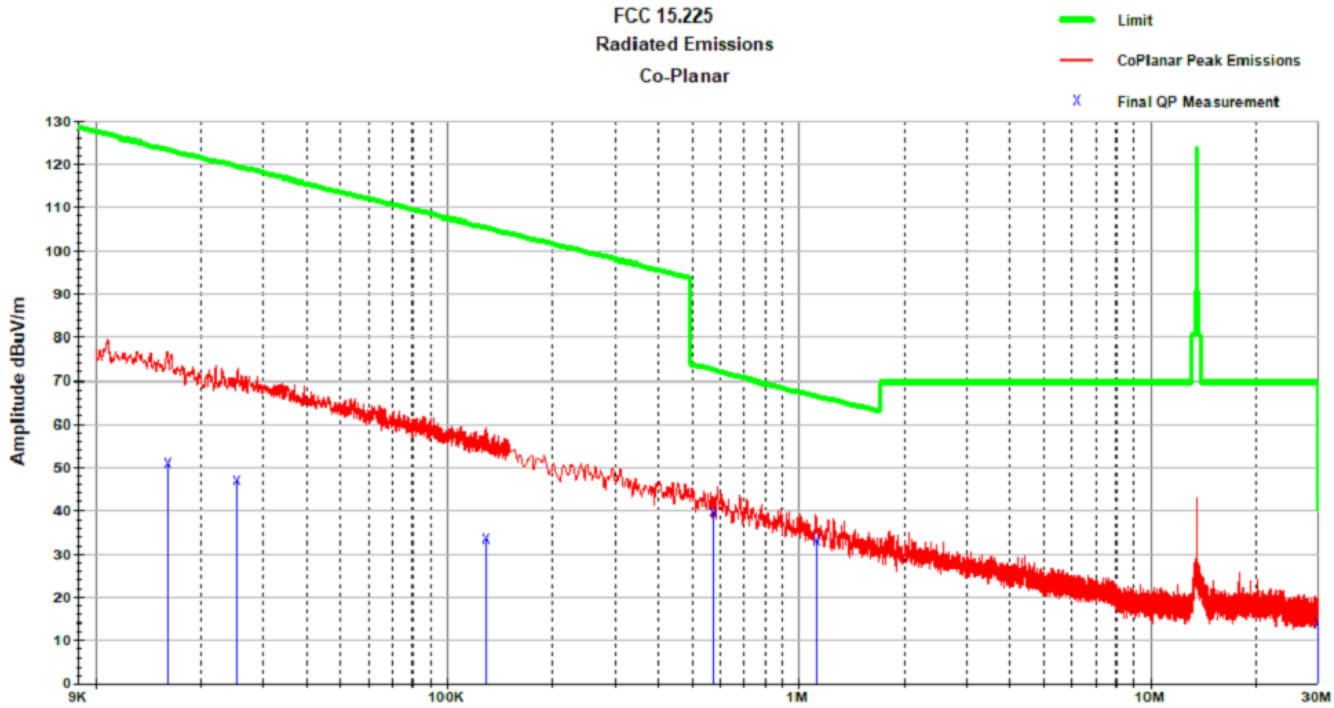
Software:
“RSE 9k - 30M Red Loop 200117” TILE! profile dated 01 January 2020
“RSE 30-1000 MHz T7 200710” TILE! profile dated 10 July 2020

5.5 *Test Data*

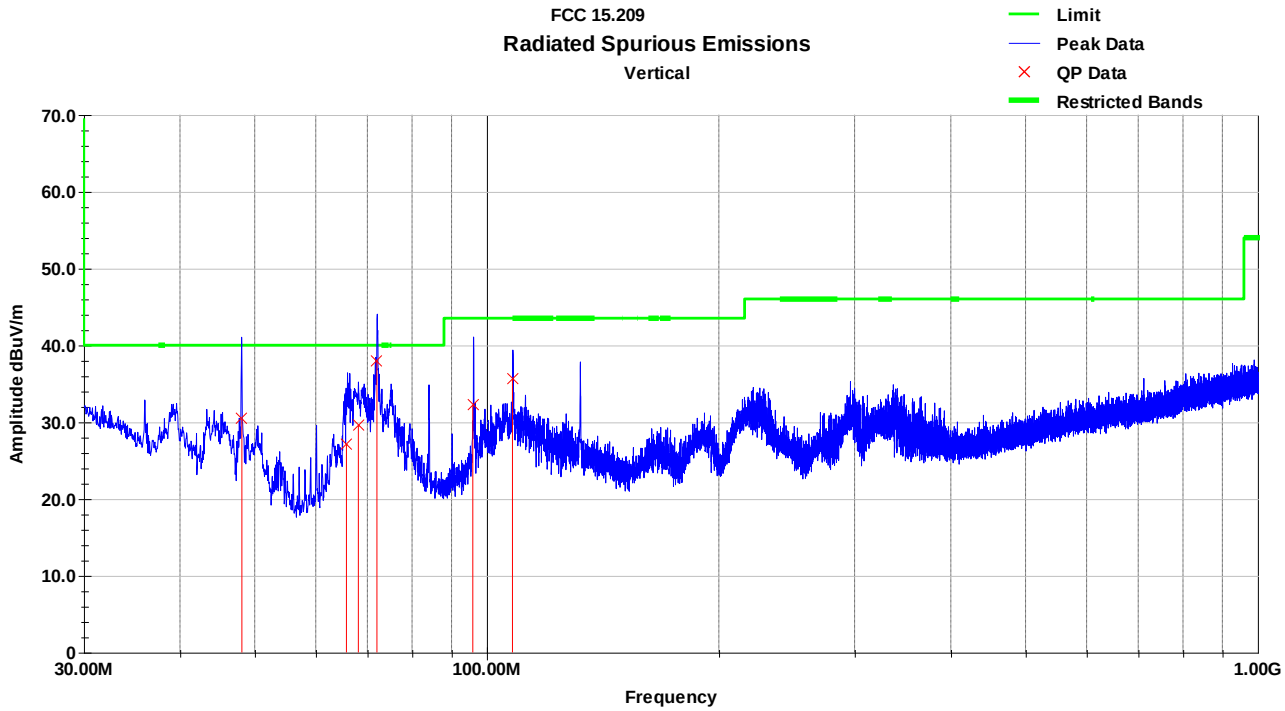
Co-Axial Radiated Emissions Data (9kHz-30MHz) – 3 meters



Co-Planar Radiated Emissions Data (9kHz-30MHz) – 3 meters



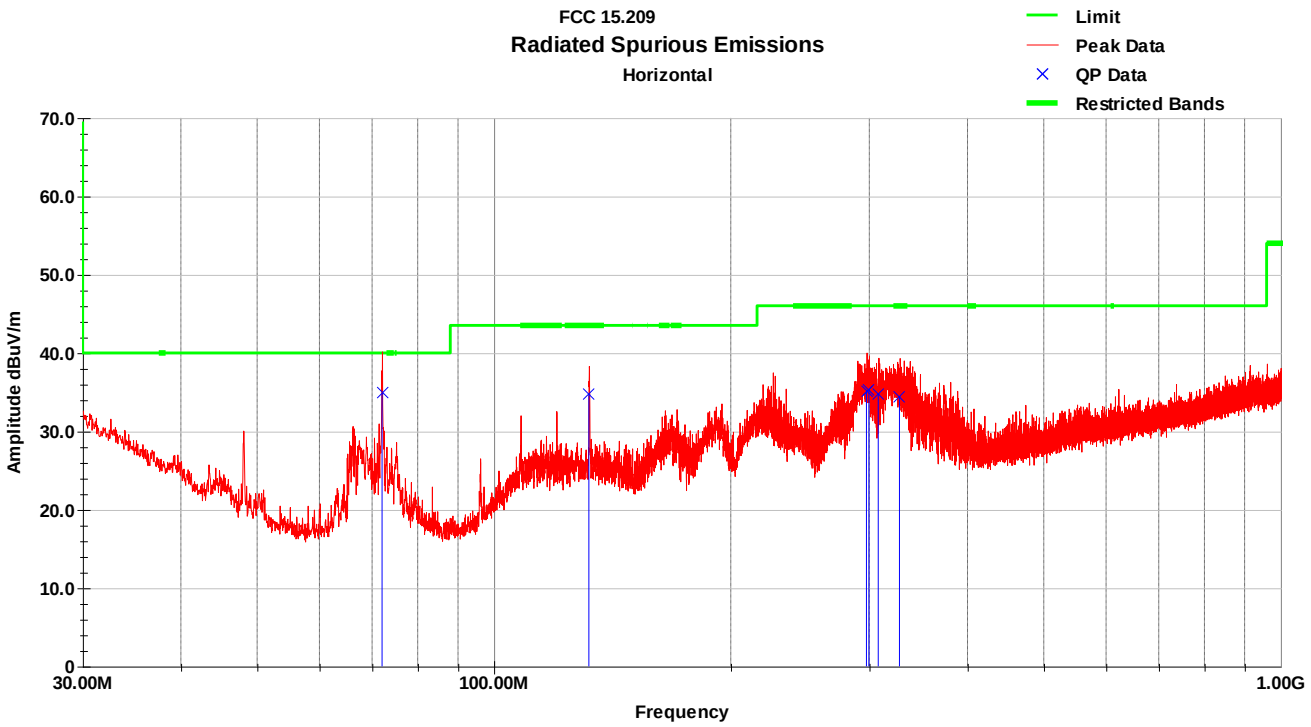
Vertical Radiated Emissions Plot (30-1000MHz)



Vertical Radiated Emissions Data (30-1000MHz)

Frequency MHz	Raw QP (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	QP Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
48.11	45.8	V	246.0	142.0	9.5	6.7	31.5	30.4	40.0	-9.6
65.77	43.9	V	268.0	165.0	7.9	6.8	31.4	27.1	40.0	-12.9
68.14	46.2	V	36.0	112.0	8.0	6.8	31.4	29.6	40.0	-10.4
72.03	54.4	V	132.0	127.0	8.2	6.8	31.4	38.0	40.0	-2.0
95.89	47.4	V	83.0	250.0	9.2	7.0	31.3	32.2	43.5	-11.3
107.97	47.9	V	8.0	123.0	12.0	7.0	31.3	35.6	43.5	-7.9
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Horizontal Radiated Emissions Plot (30-1000MHz)



Horizontal Radiated Emissions Data (30-1000MHz)

Frequency MHz	Raw QP (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	QP Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
72.07	51.3	H	84.0	241.0	8.2	6.8	31.4	34.9	40.0	-5.1
132.03	45.0	H	72.0	232.0	13.8	7.2	31.2	34.8	43.5	-8.8
297.57	44.2	H	196.0	113.0	14.1	7.8	31.0	35.1	46.0	-10.9
299.68	44.3	H	198.0	100.0	14.2	7.8	31.0	35.2	46.0	-10.8
307.98	43.5	H	196.0	101.0	14.4	7.9	31.0	34.8	46.0	-11.2
327.72	42.7	H	27.0	101.0	14.8	7.9	30.9	34.5	46.0	-11.6
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

6 Frequency Stability

6.1 *Test Result*

Test Description	Basic Standards	Test Result
Frequency Stability	FCC 15.225(e) RSS-210 B.6(b) ANSI C63.10	Compliant

6.2 *Test Method*

The EUT was placed inside the Environmental Chamber and allowed to stabilize to each set temperature for a minimum of thirty minutes before any measurements were made. The EUT fundamental transmission was coupled to the spectrum analyzer using a near field probe.

6.3 *Test Site*

SGS EMC Laboratory, Suwanee, GA

6.4 *Test Equipment*

Test End Date: 24-Jul-2020 Tester: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
DC POWER SUPPLY	KPS305D	Eventex	17003	VBU
MULTIMETER	87V	Fluke	B079677	16-Aug-2020
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	27-Dec-2021
ENVIRONMENTAL TEST CHAMBER	T2RC	TENNEY ENVIRONMENTAL	B094877	CNR

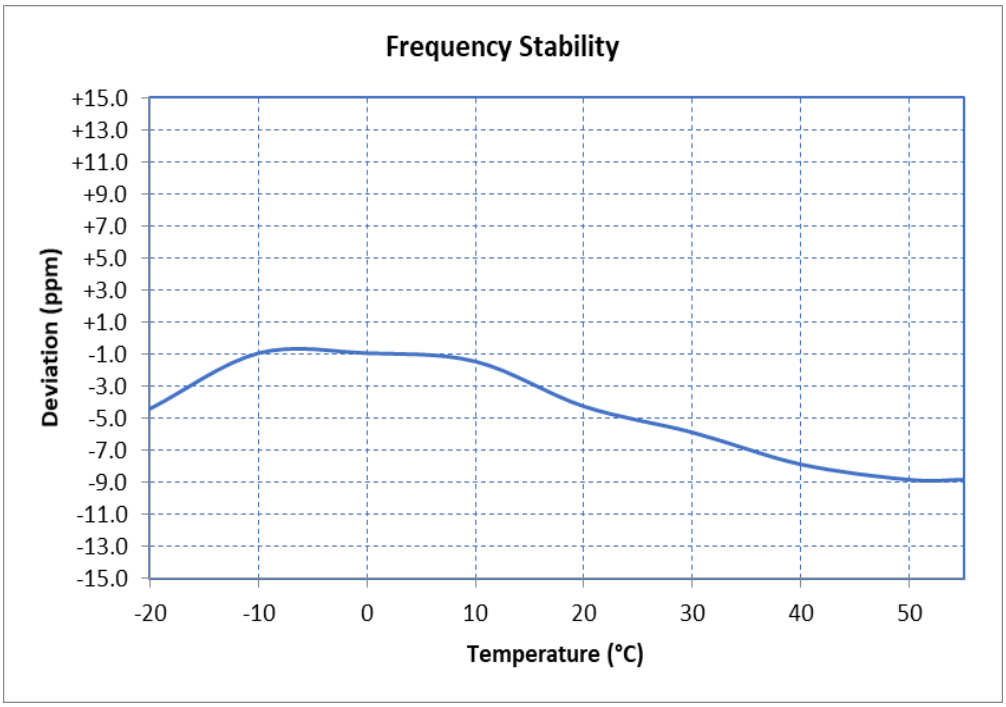
- Unless otherwise noted, equipment is on a 1-year calibration cycle.

6.5 *Test Data*

The carrier frequency shall not depart from the reference frequency by more than ±100 ppm.

RFID 13.56 MHz

Voltage %	Power VD_C	Temp °C	Frequency Hz	Freq Dev	Freq Dev ppm	Deviation %
100%	5.00	+20 (Ref)	13,559,942	-58	-4.28	-0.000428
100%	5.00	-20	13,559,940	-60	-4.42	-0.000442
100%	5.00	-10	13,559,987	-13	-0.96	-0.000096
100%	5.00	0	13,559,987	-13	-0.96	-0.000096
100%	5.00	+10	13,559,980	-20	-1.47	-0.000147
100%	5.00	+20	13,559,942	-58	-4.28	-0.000428
100%	5.00	+30	13,559,920	-80	-5.90	-0.000590
100%	5.00	+40	13,559,893	-107	-7.89	-0.000789
100%	5.00	+50	13,559,880	-120	-8.85	-0.000885
100%	5.00	+55	13,559,880	-120	-8.85	-0.000885
115%	5.75	+20	13,559,925	-75	-5.53	-0.000553
85%	4.25	+20	13,559,925	-75	-5.53	-0.000553



7 Conducted Emissions

7.1 *Test Result*

Test Description	Basic Standards	Test Result
Conducted Emissions, Class B	RSS-GEN, Issue 4 ANSI C63.4:2014	Compliant

7.2 *Test Method*

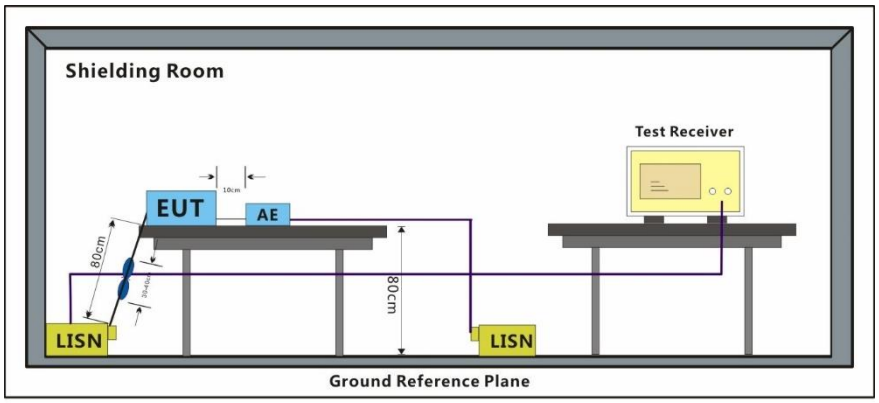
With the receiver's resolution bandwidth was set to 9 kHz the exploratory scans were performed over the measuring frequency range (0.15MHz to 30MHz) using a max hold mode incorporating a Peak detector and Average detector and using the TILE! software. The final test data was measured using a Quasi-Peak detector and Average detector and compared against the limits indicated in the table below.

Frequency Range	Class A Limits (dBµV)	Class B Limits (dBµV)
0.15 to 0.5 MHz	Avg 66 QP 79	Avg 56 to 46 QP 66 to 56
0.5 to 5 MHz	Avg 60 QP 73	Avg 46 Pk 56
5 to 30 MHz	Avg 60 QP 73	Avg 50 Pk 60

7.3 *Test Site*

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions
Temperature: 22.2°C
Relative Humidity: 53.0%



7.4 *Test Equipment*

Test End Date: 27-Jul-2020 Tester: JOP

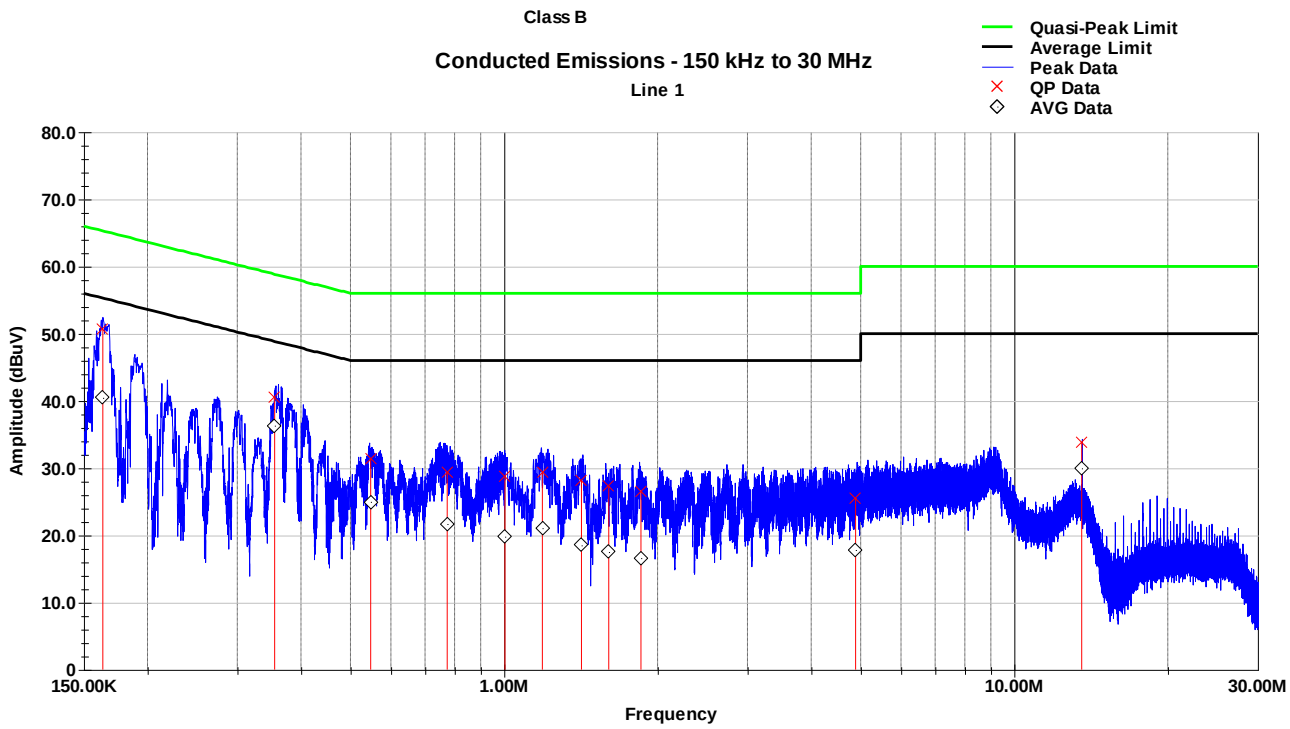
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
RF CABLE	UC-N-MM-78	MAURY MICROWAVE	17017	5-Sep-2020
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	6-Apr-2021
LINE IMPEDANCE STABILIZATION NETWORK	NNB 51	TESEQ	B087573	16-Dec-2020

Note: The equipment calibration period is 1 year.

Software:
“181112 Conducted Emissions Tile7” TILE! profile dated 12 November 2018

7.5 *Test Data*

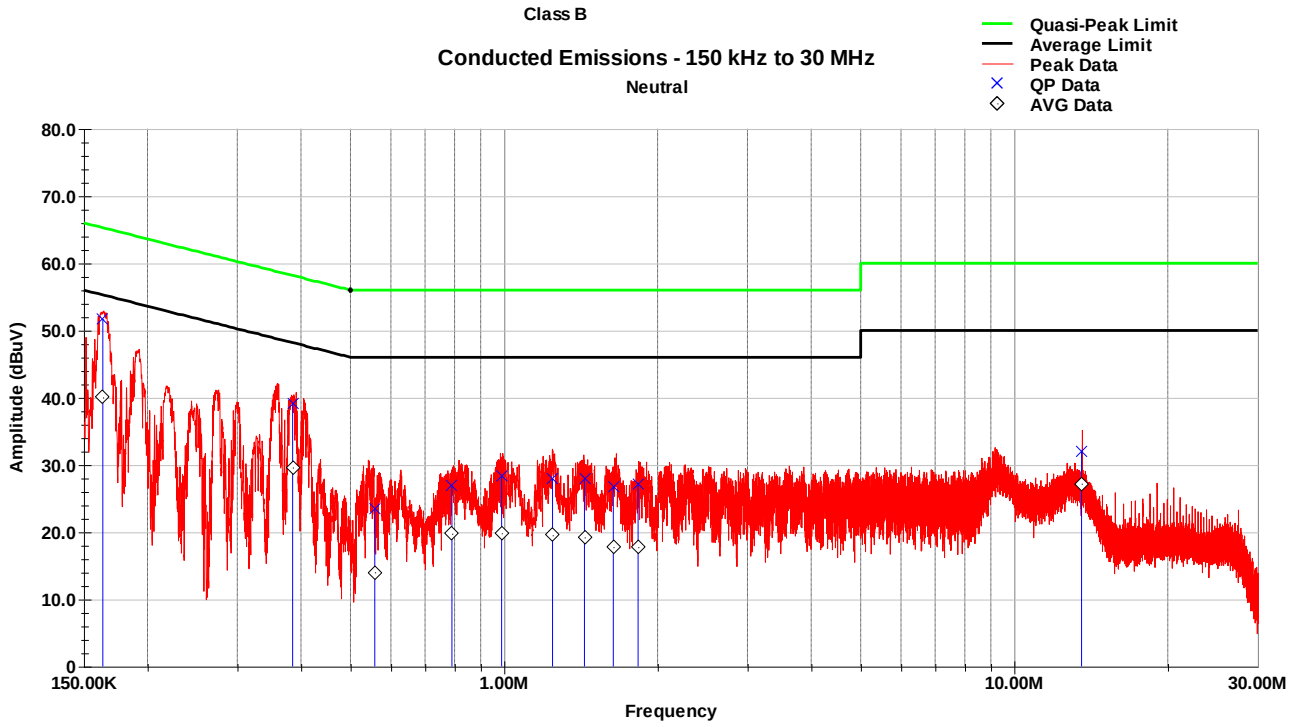
Line 1 Conducted Emissions Plot 150-30MHz



Line 1 Conducted Emissions Data 150-30MHz

Frequency MHz	QP Value dBuV	QP Limit dBuV	QP Margin dB	Avg Value dBuV	Avg Limit dBuV	Avg Margin dB
0.164	50.6	65.3	-14.7	40.5	55.3	-14.8
0.355	40.5	58.8	-18.3	36.3	48.8	-12.5
0.548	31.4	56.0	-24.6	25.0	46.0	-21.0
0.774	29.4	56.0	-26.6	21.7	46.0	-24.3
1.004	28.7	56.0	-27.3	19.8	46.0	-26.2
1.189	29.4	56.0	-26.6	21.1	46.0	-24.9
1.418	28.1	56.0	-27.9	18.5	46.0	-27.5
1.604	27.3	56.0	-28.7	17.5	46.0	-28.5
1.855	26.5	56.0	-29.5	16.6	46.0	-29.4
4.888	25.5	56.0	-30.5	17.8	46.0	-28.2
13.559	33.9	60.0	-26.1	30.0	50.0	-20.0

Neutral Conducted Emissions Plot 150-30MHz



Neutral Conducted Emissions Data 150-30MHz

Frequency MHz	QP Value dBuV	QP Limit dBuV	QP Margin dB	Avg Value dBuV	Avg Limit dBuV	Avg Margin dB
0.164	51.7	65.3	-13.6	40.0	55.3	-15.3
0.385	39.1	58.2	-19.1	29.6	48.2	-18.6
0.558	23.5	56.0	-32.5	14.0	46.0	-32.0
0.791	26.9	56.0	-29.1	19.8	46.0	-26.2
0.989	28.4	56.0	-27.6	19.8	46.0	-26.2
1.244	27.9	56.0	-28.1	19.5	46.0	-26.5
1.437	28.0	56.0	-28.0	19.2	46.0	-26.8
1.637	26.7	56.0	-29.3	17.8	46.0	-28.2
1.831	27.0	56.0	-29.0	17.8	46.0	-28.2
13.557	32.1	60.0	-27.9	27.2	50.0	-22.8

8 Measurement Uncertainty

No.	Item	Measurement Uncertainty
1	Radio Frequency	± 7.25 x 10^{-8}
2	Duty cycle	± 0.37%
3	Occupied Bandwidth	± 3%
4	Conduction emission	± 3.0dB (150kHz to 30MHz)
5	RF conducted power	± 0.75dB
6	RF power density	± 2.84dB
7	Conducted Spurious emissions	± 0.75dB
8	RF Radiated power	± 4.5dB (Below 1GHz)
		± 4.8dB (Above 1GHz)
9	Radiated Spurious emission test	± 4.5dB (Below 1GHz)
		± 4.8dB (Above 1GHz)
10	Temperature test	± 1°C
11	Humidity test	± 3%
12	Supply voltages	± 1.5%
13	Time	± 3%

9 Revision History

Revision Level	Description of changes	Revision Date
0	Initial release	03 December 2020
1	- Added Serial Number to Section 2.3 - Corrected emission plots to legible size	04 January 2021
2	- Added CAB ID to Section 2.2	18 January 2021