Report on the FCC and IC Testing of the Marquardt GmbH

Model: SE1

In accordance with FCC 47 CFR Part 15C and ISED Canada RSS-210 and ISED Canada RSS-GEN

Prepared for: Marquardt GmbH
Schloßstrasse 16
78604 Rietheim-Weilheim
Germany

FCC ID: IYZSE1
IC: 2701A-SE1

COMMERCIAL-IN-CONFIDENCE

Date: 2019-09-02
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RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Project Management	Michael Ingerl	2019-09-02	
Authorised Signatory	Markus Biberger	2019-09-02	

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD Product Service document control rules.

ENGINEERING STATEMENT
The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on a sample equipment to demonstrate limited compliance with FCC 47 CFR Part 15C and ISED Canada RSS-210 and ISED Canada RSS-GEN. The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Michael Ingerl	2019-09-02	

Laboratory Accreditation	Laboratory recognition	ISED Canada test site registration
DAkkS Reg. No. D-PL-11321-11-02	Registration No. BNetzA-CAB-16/21-15	3050A-2

EXECUTIVE SUMMARY
A sample of this product was tested and found to be compliant with FCC 47 CFR Part 15C, ISED Canada RSS-210 and ISED Canada RSS-GEN:2016, Issue 09 (08-2016) and Issue 04 (11-2014).

Trade Register Munich
HRB 85742
VAT ID No. DE129484267
Information pursuant to Section 2(1)
DL-InfoV (Germany) at
www.tuev-sued.com/imprint

Managing Directors:
Dr. Peter Havel (CEO)
Dr. Jens Butenandt

Phone: +49 (0) 9421 55 22-0
Fax: +49 (0) 9421 55 22-99
www.tuev-sued.de

TÜV SÜD Product Service GmbH
Äußere Frühlingstraße 45
94315 Straubing
Germany

Product Service

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Product Service

1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	2019-09-02

Table 1

1.2 Introduction

Applicant	Marquardt GmbH
Manufacturer	Marquardt Switches (Shanghai) Co., Ltd.
Model Number(s)	SE1
Serial Number(s)	---
Software Version	SW_19_24_0004_KDSRTA1
Number of Samples Tested	1
Test Specification/Issue/Date	FCC 47 CFR Part 15C, ISED Canada RSS-210 and ISED Canada RSS-GEN:2016, Issue 09 (08-2016) and Issue 04 (11-2014), FCC rule Part 2.1093, KDB 447498 D01, RSS-102 Issue 5
Test Plan/Issue/Date	---
Order Number	6200359433
Date of Receipt of EUT	2019-08-05
Start of Test	2019-08-20
Finish of Test	2019-08-27
Name of Engineer(s)	Michael Ingerl
Related Document(s)	ANSI C63.10 (2013) ANSI C63.4: 2014

Product Service

1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 15C and ISED Canada RSS-210, ISED Canada RSS-GEN, FCC rule Part 2.1093, KDB 447498 D01 and RSS-102 Issue 5 is shown below.

Section	Specification Clause	Test Description	Result	Comments/Base Standard
Configuration and Mode: DC Powered 12 V – Transmitting continuously				
2.1	15.249 (b)(2), N/A and 6.11	Frequency Tolerance Under Temperature Variations	Pass	ANSI C63.10 (2013)
2.2	15.209, 4.3 and 6.13	Field Strength of any Emission	Pass	ANSI C63.10 (2013)
2.3	15.215 (c), N/A and 6.6	20 dB Bandwidth	Pass	ANSI C63.10 (2013)
2.4	15.207, N/A and 8.8	AC Power Line Conducted Emissions	Pass	ANSI C63.10 (2013)
2.5	15.205, 4.1 and 8.10	Restricted Band Edges	Pass	ANSI C63.10 (2013)
2.6	15.107 and 6.1	Exposure of Humans to RF Fields and SAR exclusion threshold	Pass	ANSI C63.4: 2014

Table 2

Product Service

1.4 Product Information

1.4.1 Technical Description

Equipment characteristics	
Type designation:	SE1
Type of equipment:	Wireless Control Module
Operating Frequency:	21.85 kHz
Number of RF channels:	1
Modulation:	BPSK
Modulation Content:	Digital data
Data Rate:	5.4 kBit/s
Antenna:	Serial capacity and inductivity resonance circuit
Standby mode:	Not Applicable
Power supply:	External DC supply Nominal: 12 V Minimum: 9 V Maximum: 16 V Nominal frequency: DC

1.5 Deviations from the Standard

none

Product Service

1.6 EUT Modification Record

The table below details modifications made to the EUT during the test programme.
The modifications incorporated during each test are recorded on the appropriate test pages.

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
0	As supplied by the customer	Not Applicable	Not Applicable

Table 3

1.7 Test Location

TÜV SÜD Product Service conducted the following tests at our Straubing Test Laboratory.

Test Name	Name of Engineer(s)
Configuration and Mode: DC Powered 12 V – Transmitting continuously	
Frequency Tolerance Under Temperature Variations	Michael Ingerl
Field Strength of any Emission	Michael Ingerl
20 dB Bandwidth	Michael Ingerl
AC Power Line Conducted Emissions	Michael Ingerl
Restricted Band Edges	Michael Ingerl
Exposure of Humans to RF Fields and SAR exclusion threshold	Michael Ingerl

Table 4

Office Address:

Äußere Frühlingstraße 45
94315 Straubing
Germany

Product Service

2 Test Details

2.1 Frequency Tolerance Under Temperature Variations

2.1.1 Specification Reference

ISED Canada RSS-210 and ISED Canada RSS-GEN, Clause N/A and 6.11

2.1.2 Equipment Under Test and Modification State

SE1, S/N: --- - Modification State 0

2.1.3 Date of Test

2019-08-21

2.1.4 Test Method

The EUT was set to transmit on maximum power with normal modulation. A frequency counter was used to measure the frequency error. The temperature was adjusted between - 20°C and +50°C.

2.1.5 Environmental Conditions

Ambient Temperature	21.0 °C
Relative Humidity	32.0 %

2.1.6 Test Results

DC Powered 12 V – Transmitting continuously

Temperature	Voltage	kHz
- 20°C	12.0 V DC	21.85812
+ 20°C	10.2 V DC	21.85750
+ 20°C	12.0 V DC	21.85750
+ 20°C	13.8 V DC	21.85750
+ 50°C	12.0 V DC	21.85750

Table 5

ISED Canada RSS-210 Limit Clause

None specified

Product Service

2.1.7 Test Location and Test Equipment Used

This test was carried out in a non-shielded room.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Spectrum Analyzer	Rohde & Schwarz	FSV40	20219	12	2020-01-31
Climatic test chamber	ESPEC	PL-2J	18843	24	2020-03-31

Table 6

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment
N/A - Not Applicable

Product Service

2.2 Field Strength of any Emission

2.2.1 Specification Reference

FCC 47 CFR Part 15C, ISED Canada RSS-210 and ISED Canada RSS-GEN, Clause 15.209, 4.3 and 6.13

2.2.2 Equipment Under Test and Modification State

SE1, S/N: --- - Modification State 0

2.2.3 Date of Test

2019-08-20

2.2.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 6.3, 6.4 and 6.5. and ISED Canada RSS-Gen clause 6.13.
Measurements were made at a distance of 3 m. The limit lines shown on the plot were extrapolated from either 300 m or 30 m to the measurement distance of 3 m in accordance with ANSI C63.10 Clause 6.4.4.2.
For any emissions detected within 20 dB of the limit, a final measurement was made and recorded in the table below. The detector used for these measurements was a quasi-peak detector except for emissions within the bands 9 kHz to 90 kHz and 110 kHz to 490 kHz where a CISPR average detector was used.

2.2.5 Environmental Conditions

Ambient Temperature	22.0 °C
Relative Humidity	33.0 %

Product Service

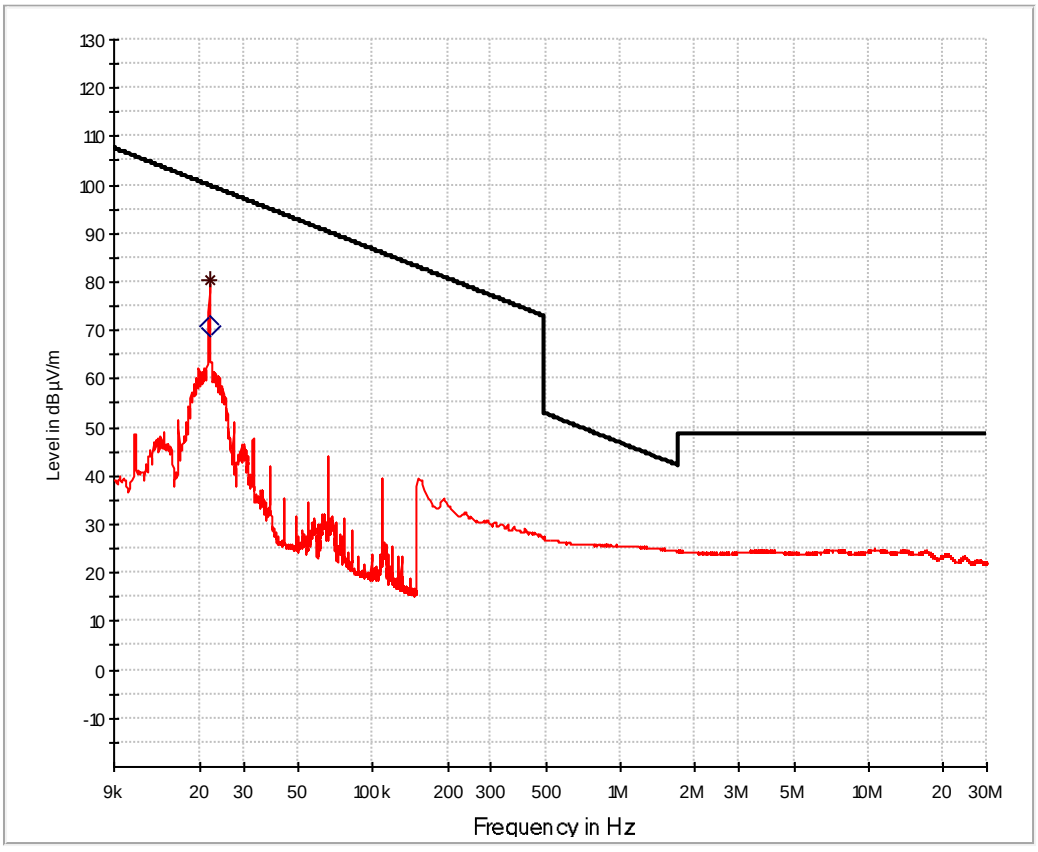
2.2.6 Test Results

DC Powered 12 V – Transmitting continuously

1. Orthogonal axis

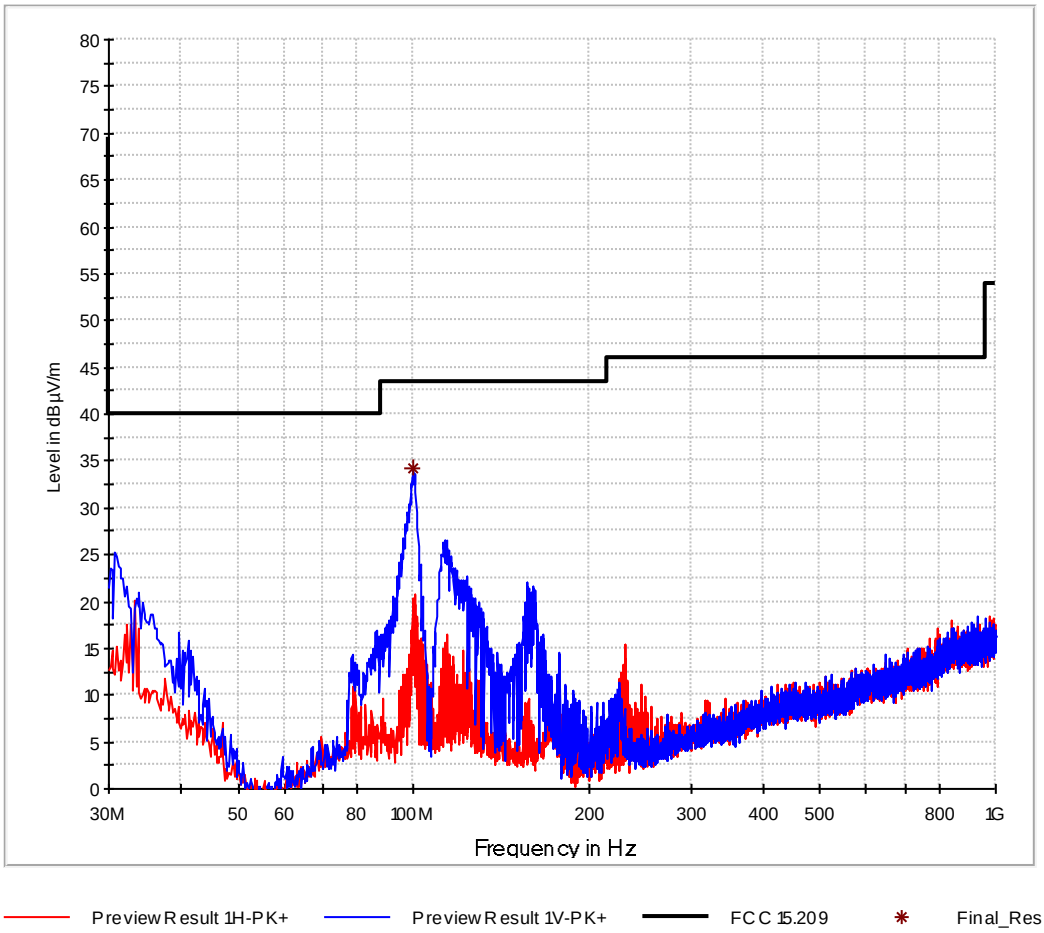
Extrapolation factor: -40 dB/decade

Frequency (MHz)	Detector	Distance d1 (m)	Distance d (m)	Reading Value (dBµV)	Correction Factor (dB/m)	Extrapolation Factor (dB)	Pulse Train Correction (dB)	Final Value (dBµV/m)	Limit (dBµV/m)	Margin (dB)
0.02185	Quasi-Peak	10	300	80.3	---	-59.1	---	21.2	40.8	**19.6**



Final Results 1:

Frequency MHz	*QuasiPeak dBµV/m*	*CAverage dBµV/m*	*Limit dBµV/m*	*Margin dB*	*Meas. Time ms*	*Bandwidth kHz*	*Pol*	*Azimuth deg*	*Corr. dB*
0.021850	---	70.91	---	---	1000.0	0.200	H	1.0	20.0
0.021850	80.32	---	99.90	19.58	1000.0	0.200	H	1.0	20.0



Final Results 1:

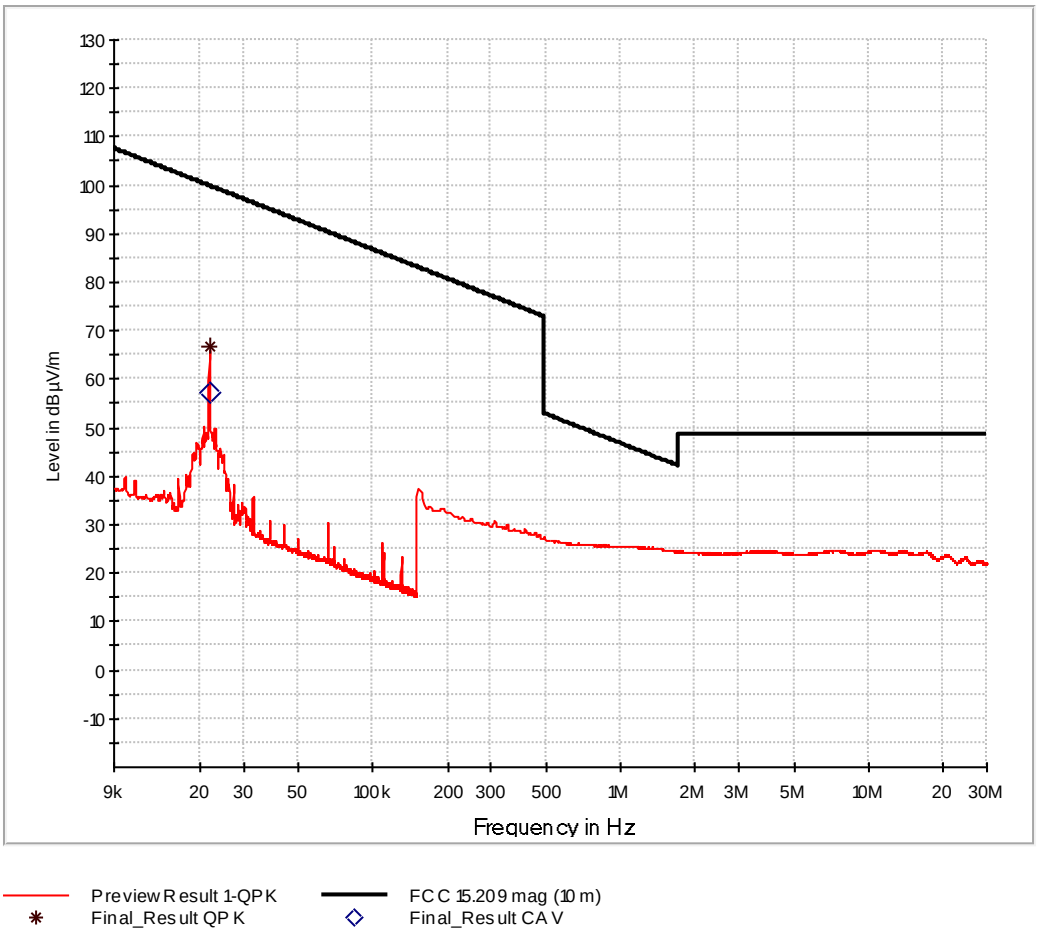
Frequency *MHz*	*MaxPeak* *dBµV/m*	*Limit* *dBµV/m*	*Margin* *dB*	*Meas. Time* *ms*	*Bandwidth* *kHz*	*Pol*	*Azimuth* *deg*	*Corr.* *dB/m*
100.034000	34.23	43.50	9.27	2.5	100.000	V	123.0	-19

Product Service

2. Orthogonal axis

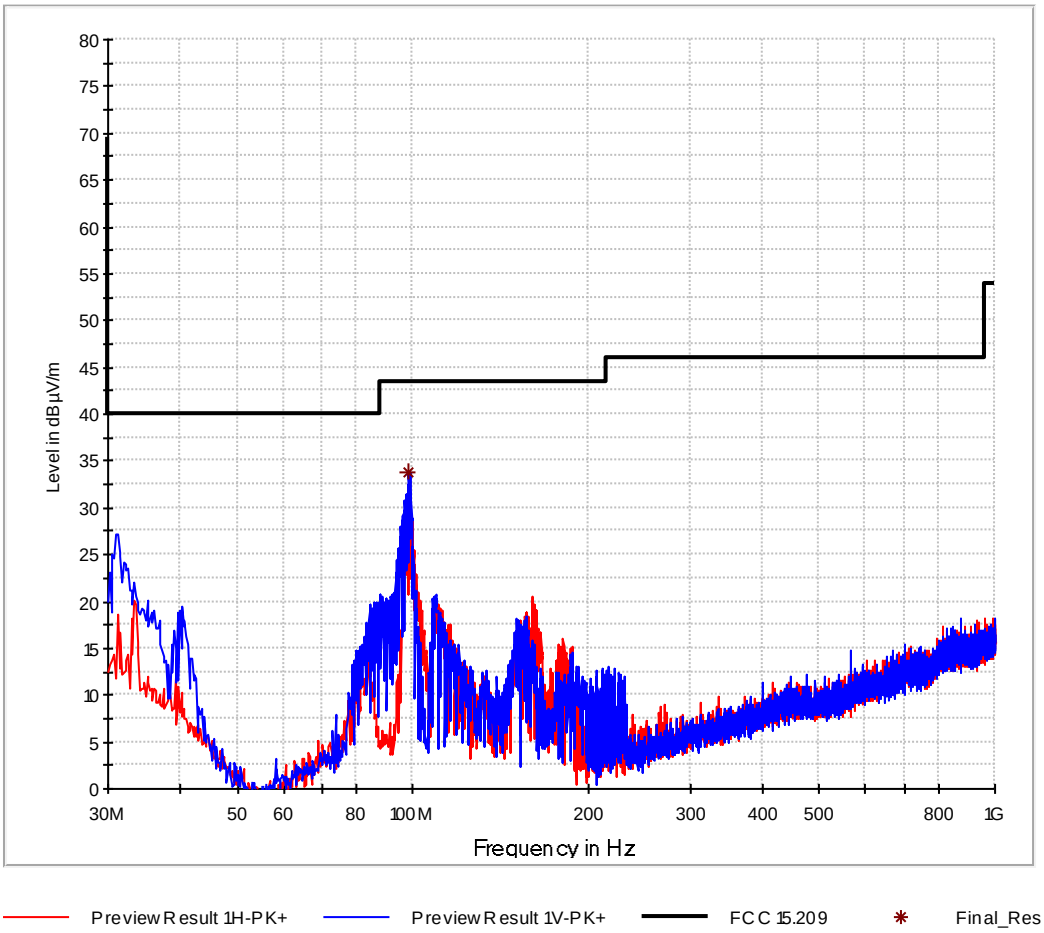
Extrapolation factor: -40 dB/decade

Frequency (MHz)	Detector	Distance d1 (m)	Distance d (m)	Reading Value (dBµV)	Correction Factor (dB/m)	Extrapolation Factor (dB)	Pulse Train Correction (dB)	Final Value (dBµV/m)	Limit (dBµV/m)	Margin (dB)
0.02185	Quasi-Peak	10	300	66.7	---	-59.1	---	7.6	40.8	**33.2**



Final Results 1:

Frequency MHz	*QuasiPeak dBµV/m*	*CAverage dBµV/m*	*Limit dBµV/m*	*Margin dB*	*Meas. Time ms*	*Bandwidth kHz*	*Pol*	*Azimuth deg*	*Corr. dB*
0.021850	---	57.32	---	---	1000.0	0.200	H	19.0	20.0
0.021850	66.72	---	99.90	33.18	1000.0	0.200	H	19.0	20.0



Final Results 1:

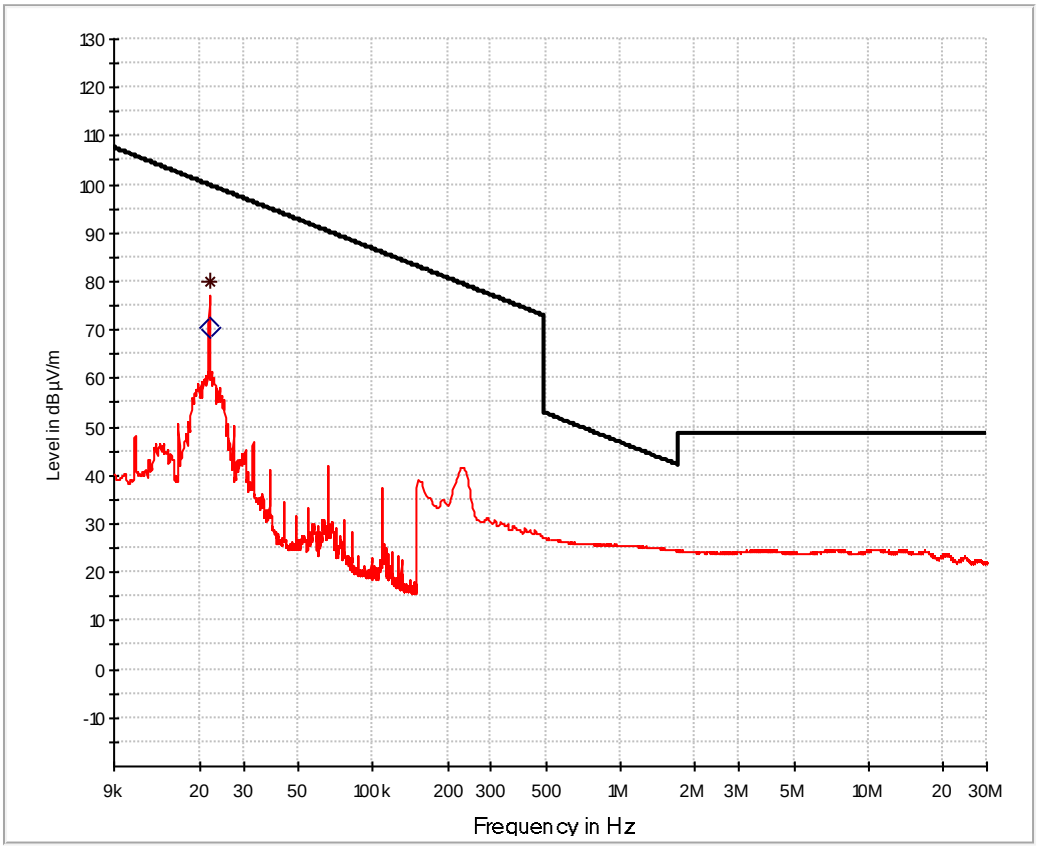
Frequency *MHz*	*MaxPeak* *dBµV/m*	*Limit* *dBµV/m*	*Margin* *dB*	*Meas. Time* *ms*	*Bandwidth* *kHz*	*Pol*	*Azimuth* *deg*	*Corr.* *dB/m*
98.482000	33.78	43.50	9.72	2.5	100.000	V	83.0	-19

Product Service

3. Orthogonal axis

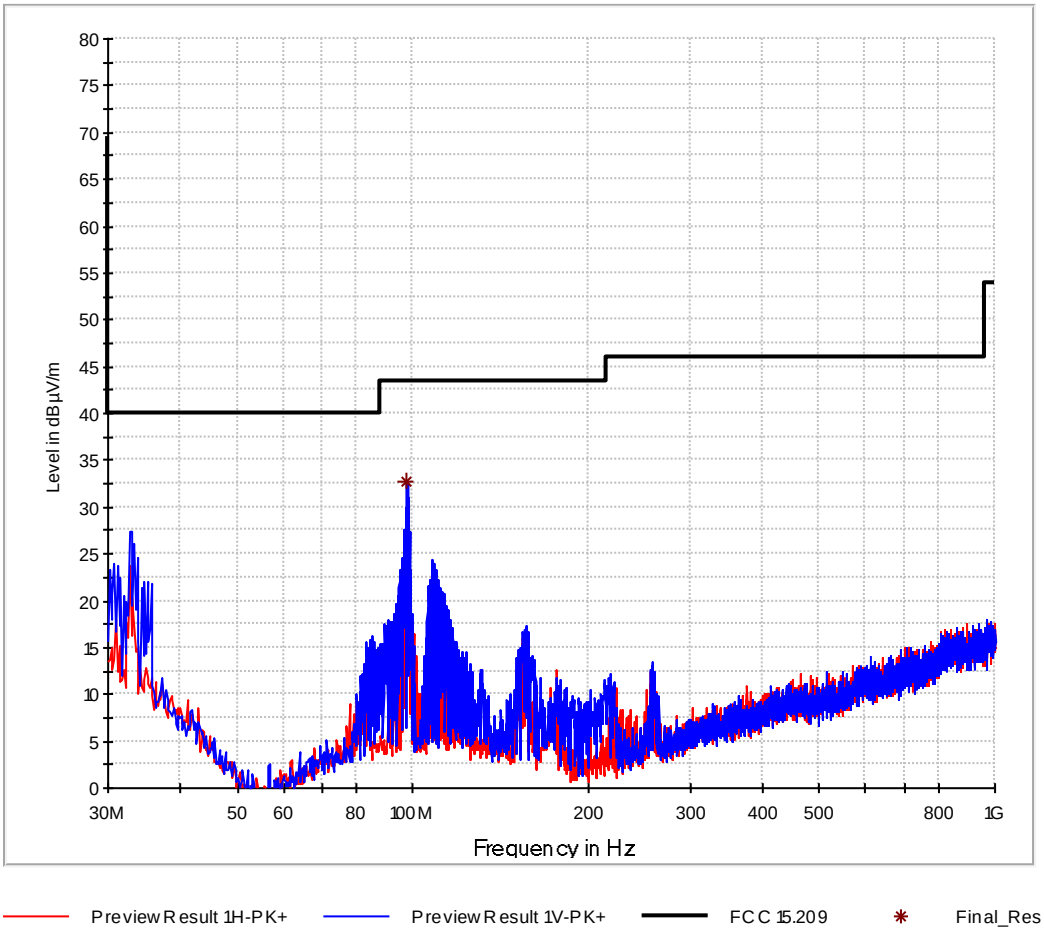
Extrapolation factor: -40 dB/decade

Frequency (MHz)	Detector	Distance d1 (m)	Distance d (m)	Reading Value (dBµV)	Correction Factor (dB/m)	Extrapolation Factor (dB)	Pulse Train Correction (dB)	Final Value (dBµV/m)	Limit (dBµV/m)	Margin (dB)
0.02185	Quasi-Peak	10	300	79.9	---	-59.1	---	20.8	40.8	**20.0**



Final Results 1:

Frequency *MHz*	*QuasiPeak* *dBµV/m*	*CAverage* *dBµV/m*	*Limit* *dBµV/m*	*Margin* *dB*	*Meas. Time* *ms*	*Bandwidth* *kHz*	*Pol*	*Azimuth* *deg*	*Corr.* *dB*
0.021850	---	70.37	---	---	1000.0	0.200	H	78.0	20.0
0.021850	79.93	---	99.90	19.97	1000.0	0.200	H	78.0	20.0



Final Results 1:

Frequency *MHz*	*MaxPeak* *dBµV/m*	*Limit* *dBµV/m*	*Margin* *dB*	*Meas. Time* *ms*	*Bandwidth* *kHz*	*Pol*	*Azimuth* *deg*	*Corr.* *dB/m*
97.900000	32.81	43.50	10.69	2.5	100.000	V	34.0	-19

FCC 47 CFR Part 15, Limit Clause 15.209

Frequency (MHz)	Field Strength (µV/m)	Measurement Distance (m)
0.009 to 0.490	2400/F (kHz)	300
0.490 to 1.705	24000/F (kHz)	30
1.705 to 30	30	30
30 to 88	100**	3
88 to 216	150**	3
216 to 960	200**	3
Above 960	500	3

Table 7 - FCC Limit

NOTE: The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission.

ISED Canada RSS-210, Limit Clause 4.4

Under no circumstance shall the level of any unwanted emissions exceed the level of the fundamental emissions.

ISED Canada RSS-Gen, Limit Clause 8.9

Frequency (MHz)	Field Strength (µV/m)	Measurement Distance (m)
0.009 to 0.490	2400/F (kHz)	300
0.490 to 1.705	24000/F (kHz)	30
1705 to 30	30	30

Table 8 - IC Limit, Below 30 MHz

Frequency (MHz)	Field Strength (µV/m at 3 metres)
30 to 88	100
88 to 216	150
216 to 960	200
Above 960	500

Table 9 - IC Limit, Above 30 MHz

Product Service

2.2.7 Test Location and Test Equipment Used

This test was carried out in Semi anechoic room - cabin no. 8.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Loop Antenna	Rohde & Schwarz	HFH2-Z2	18876	36	2022-08-31
TRILOG Antenna (4db)	Schwarzbeck	VULB 9162	20116	36	2022-01-31
EMI test receiver	Rohde & Schwarz	ESW26	28268	12	2020-06-30
EMC measurement software	Rohde & Schwarz	EMC32-ME+	19719	N/A	N/A

Table 10

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment
N/A - Not Applicable

Product Service

2.3 20 dB Bandwidth

2.3.1 Specification Reference

FCC 47 CFR Part 15C, ISED Canada RSS-210 and ISED Canada RSS-GEN, Clause 15.215 (c), N/A and 6.6

2.3.2 Equipment Under Test and Modification State

SE1, S/N: --- - Modification State 0

2.3.3 Date of Test

2019-08-21

2.3.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 6.9.1.

2.3.5 Environmental Conditions

Ambient Temperature	23.0 °C
Relative Humidity	32.0 %

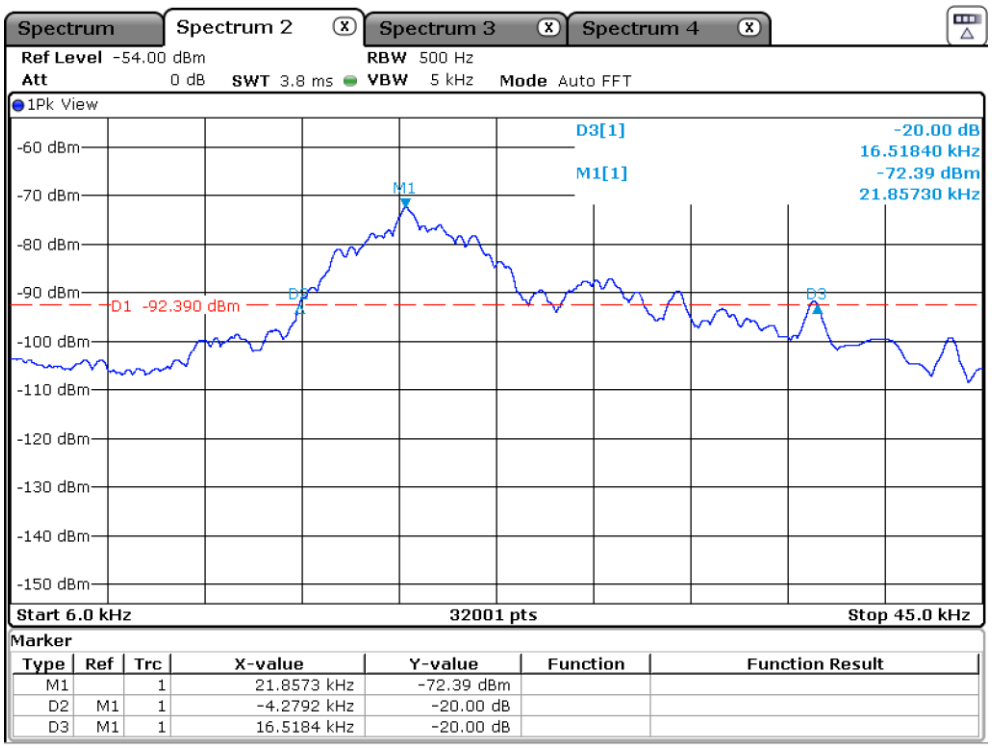
2.3.6 Test Results

DC Powered 12 V – Transmitting continuously

Frequency (kHz)	20 dB Bandwidth (kHz)	99% Occupied Bandwidth (kHz)	F_{LOWER} (kHz)	F_{UPPER} (kHz)
21.85	20.80	22.39	17.58	38.38

Table 11

Product Service

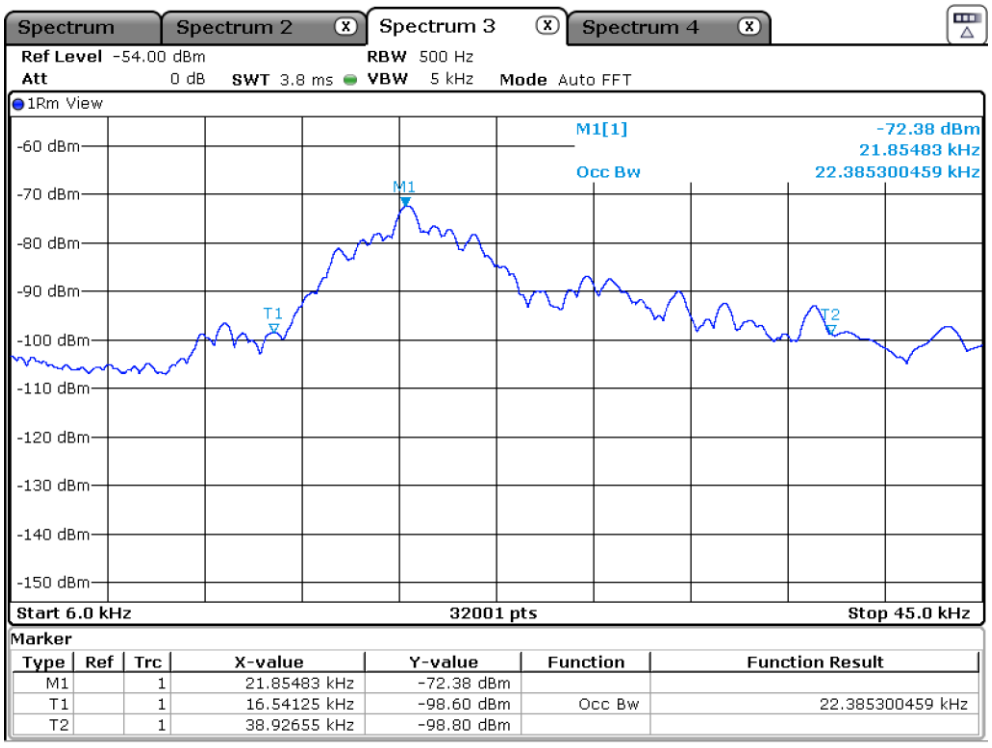


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	21.8573 kHz	-72.39 dBm		
D2	M1	1	-4.2792 kHz	-20.00 dB		
D3	M1	1	16.5184 kHz	-20.00 dB		

Date: 21.AUG.2019 12:13:23

20 dB Bandwidth



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	21.85483 kHz	-72.38 dBm		
T1		1	16.54125 kHz	-98.60 dBm	Occ Bw	22.385300459 kHz
T2		1	38.92655 kHz	-98.80 dBm		

Date: 21.AUG.2019 12:14:09

99% Occupied Bandwidth

FCC 47 CFR Part 15, Limit Clause 15.215 (c)

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.

ISED Canada RSS 210 and ISED Canada RSS GEN, Limit Clause

None specified.

2.3.7 Test Location and Test Equipment Used

This test was carried out in a non-shielded room.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Spectrum Analyzer	Rohde & Schwarz	FSV40	20219	12	2020-01-31
Climatic test chamber	ESPEC	PL-2J	18843	24	2020-03-31

Table 12

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment
N/A - Not Applicable

Product Service

2.4 AC Power Line Conducted Emissions

2.4.1 Specification Reference

FCC 47 CFR Part 15C, ISED Canada RSS-210 and ISED Canada RSS-GEN, Clause 15.207, N/A and 8.8

2.4.2 Equipment Under Test and Modification State

SE1, S/N: --- - Modification State 0

2.4.3 Date of Test

2019-08-27

2.4.4 Test Method

2.4.5 Environmental Conditions

Ambient Temperature	21.0 °C
Relative Humidity	30.0 %

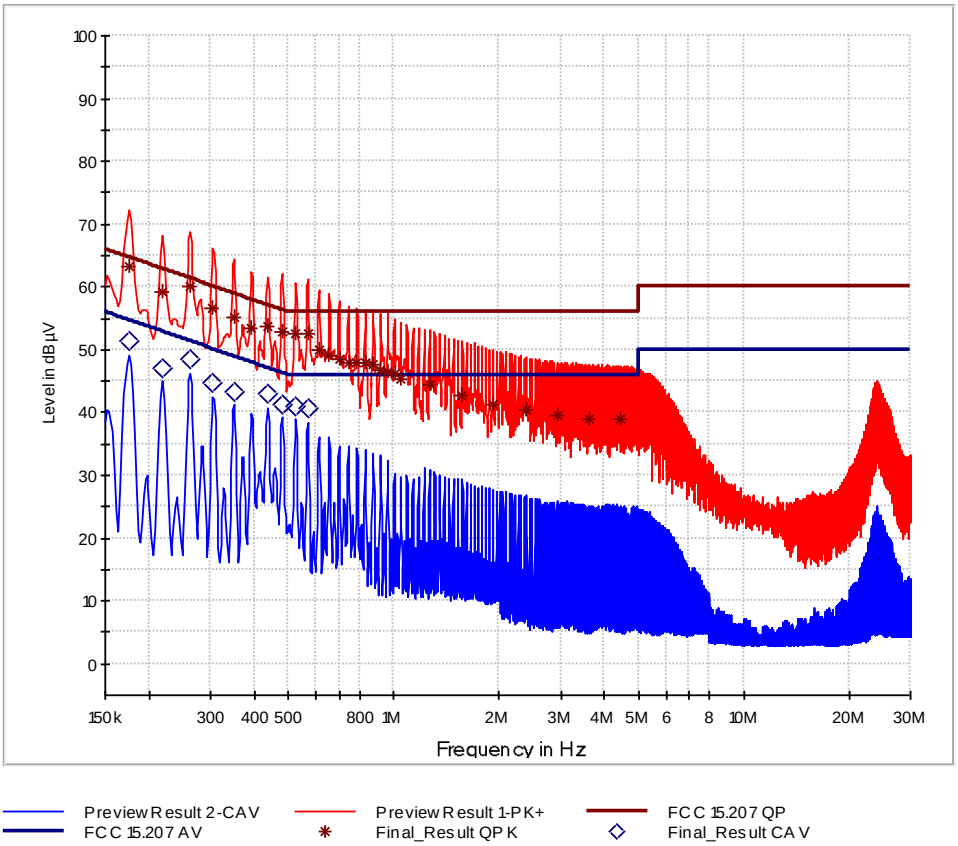
2.4.6 Test Results

DC Powered 12 V – Transmitting continuously

Applied supply Voltage:	115 V AC
Applied supply frequency:	60 Hz

Product Service

Line Plus - 150k to 30 MHz



Final Results 1:

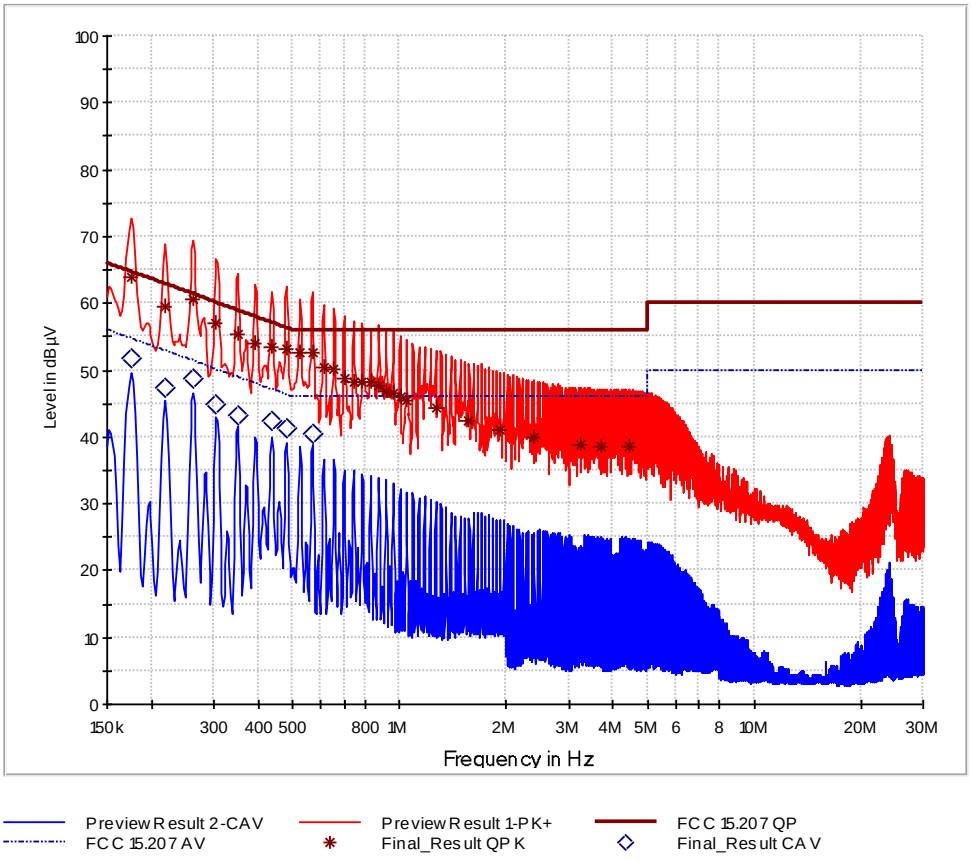
Frequency MHz	QuasiPeak dBµV	CAverage dBµV	Limit dBµV	Margin dB	Meas. Time ms	Bandwidth kHz	PE	Corr. dB
0.174750	---	51.51	54.73	3.23	1000.0	9.000	GND	10.0
0.174750	63.38	---	64.73	1.35	1000.0	9.000	GND	10.0
0.219750	---	47.21	52.83	5.62	1000.0	9.000	GND	10.0
0.219750	59.24	---	62.83	3.59	1000.0	9.000	GND	10.0
0.262500	60.15	---	61.35	1.20	1000.0	9.000	GND	10.0
0.262500	---	48.44	51.35	2.91	1000.0	9.000	GND	10.0
0.305250	56.62	---	60.10	3.48	1000.0	9.000	GND	10.0
0.305250	---	44.78	50.10	5.32	1000.0	9.000	GND	10.0
0.350250	---	43.27	48.96	5.69	1000.0	9.000	GND	10.0
0.350250	55.26	---	58.96	3.69	1000.0	9.000	GND	10.0
0.393000	53.56	---	58.00	4.44	1000.0	9.000	GND	10.0
0.438000	53.73	---	57.10	3.36	1000.0	9.000	GND	10.0
0.438000	---	42.90	47.10	4.20	1000.0	9.000	GND	10.0
0.480750	52.87	---	56.33	3.45	1000.0	9.000	GND	10.0
0.480750	---	41.38	46.33	4.95	1000.0	9.000	GND	10.0
0.523500	---	41.05	46.00	4.95	1000.0	9.000	GND	10.0
0.525750	52.50	---	56.00	3.50	1000.0	9.000	GND	10.0
0.568500	---	40.74	46.00	5.26	1000.0	9.000	GND	10.0
0.568500	52.49	---	56.00	3.51	1000.0	9.000	GND	10.0
0.613500	49.97	---	56.00	6.03	1000.0	9.000	GND	10.0
0.654000	49.14	---	56.00	6.86	1000.0	9.000	GND	10.0
0.699000	48.65	---	56.00	7.35	1000.0	9.000	GND	10.0
0.741750	48.03	---	56.00	7.97	1000.0	9.000	GND	10.0

Product Service

Frequency MHz	QuasiPeak dBµV	CAverage dBµV	Limit dBµV	Margin dB	Meas. Time ms	Bandwidth kHz	PE	Corr. dB
0.786750	47.89	---	56.00	8.11	1000.0	9.000	GND	10.0
0.831750	47.98	---	56.00	8.02	1000.0	9.000	GND	10.0
0.874500	47.52	---	56.00	8.48	1000.0	9.000	GND	10.0
0.919500	46.78	---	56.00	9.22	1000.0	9.000	GND	10.0
0.962250	46.56	---	56.00	9.44	1000.0	9.000	GND	10.0
1.005000	46.12	---	56.00	9.88	1000.0	9.000	GND	10.0
1.050000	45.28	---	56.00	10.72	1000.0	9.000	GND	10.0
1.268250	44.43	---	56.00	11.57	1000.0	9.000	GND	10.0
1.574250	42.77	---	56.00	13.23	1000.0	9.000	GND	10.1
1.923000	41.39	---	56.00	14.61	1000.0	9.000	GND	10.1
2.404500	40.32	---	56.00	15.68	1000.0	9.000	GND	10.2
2.928750	39.52	---	56.00	16.48	1000.0	9.000	GND	10.2
3.628500	39.04	---	56.00	16.96	1000.0	9.000	GND	10.3
4.458750	38.93	---	56.00	17.07	1000.0	9.000	GND	10.3

Product Service

Line Minus - 150k to 30 MHz



Final Results 1:

Frequency MHz	QuasiPeak dBµV	CAverage dBµV	Limit dBµV	Margin dB	Meas. Time ms	Bandwidth kHz	PE	Corr. dB
0.174750	---	51.75	54.73	2.98	1000.0	9.000	GND	10.0
0.174750	63.97	---	64.73	0.76	1000.0	9.000	GND	10.0
0.219750	---	47.35	52.83	5.48	1000.0	9.000	GND	10.0
0.219750	59.63	---	62.83	3.19	1000.0	9.000	GND	10.0
0.262500	60.57	---	61.35	0.79	1000.0	9.000	GND	10.0
0.262500	---	48.74	51.35	2.61	1000.0	9.000	GND	10.0
0.305250	57.01	---	60.10	3.09	1000.0	9.000	GND	10.0
0.305250	---	45.01	50.10	5.09	1000.0	9.000	GND	10.0
0.350250	---	43.17	48.96	5.78	1000.0	9.000	GND	10.0
0.350250	55.47	---	58.96	3.48	1000.0	9.000	GND	10.0
0.393000	53.88	---	58.00	4.12	1000.0	9.000	GND	10.0
0.435750	53.43	---	57.14	3.71	1000.0	9.000	GND	10.0
0.438000	---	42.56	47.10	4.54	1000.0	9.000	GND	10.0
0.480750	53.19	---	56.33	3.14	1000.0	9.000	GND	10.0
0.480750	---	41.22	46.33	5.11	1000.0	9.000	GND	10.0
0.525750	52.75	---	56.00	3.25	1000.0	9.000	GND	10.0
0.568500	---	40.50	46.00	5.50	1000.0	9.000	GND	10.0
0.568500	52.75	---	56.00	3.25	1000.0	9.000	GND	10.0
0.611250	50.50	---	56.00	5.50	1000.0	9.000	GND	10.0
0.656250	50.12	---	56.00	5.88	1000.0	9.000	GND	10.0
0.699000	48.75	---	56.00	7.25	1000.0	9.000	GND	10.0
0.741750	48.16	---	56.00	7.84	1000.0	9.000	GND	10.0

Product Service

Frequency MHz	QuasiPeak dBµV	CAverage dBµV	Limit dBµV	Margin dB	Meas. Time ms	Bandwidth kHz	PE	Corr. dB
0.786750	48.20	---	56.00	7.80	1000.0	9.000	GND	10.0
0.831750	48.30	---	56.00	7.70	1000.0	9.000	GND	10.0
0.874500	47.75	---	56.00	8.25	1000.0	9.000	GND	10.0
0.919500	46.79	---	56.00	9.21	1000.0	9.000	GND	10.0
0.962250	46.59	---	56.00	9.41	1000.0	9.000	GND	10.0
1.005000	46.06	---	56.00	9.94	1000.0	9.000	GND	10.0
1.050000	45.33	---	56.00	10.67	1000.0	9.000	GND	10.0
1.268250	44.27	---	56.00	11.73	1000.0	9.000	GND	10.0
1.574250	42.49	---	56.00	13.51	1000.0	9.000	GND	10.1
1.923000	41.11	---	56.00	14.89	1000.0	9.000	GND	10.1
2.404500	39.85	---	56.00	16.15	1000.0	9.000	GND	10.2
3.234750	38.93	---	56.00	17.07	1000.0	9.000	GND	10.2
3.716250	38.54	---	56.00	17.46	1000.0	9.000	GND	10.3
4.458750	38.48	---	56.00	17.52	1000.0	9.000	GND	10.3

FCC 47 CFR Part 15, Limit Clause 15.207 and ISED Canada RSS-GEN, Limit Clause 8.8

Frequency of Emission (MHz)	Conducted Limit (dBµV)	
	Quasi-Peak	Average
0.15 to 0.5	66 to 56*	56 to 46*
0.5 to 5	56	46
5 to 30	60	50

Table 13

*Decreases with the logarithm of the frequency.

2.4.7 Test Location and Test Equipment Used

This test was carried out in a shielded room - cabin no. 9.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
EMI test receiver	Rohde & Schwarz	ESU8	19904	12	2019-12-31
V-network	Rohde & Schwarz	ESH 3-Z6	19461	24	2019-12-31
V-network	Rohde & Schwarz	ESH 3-Z6	19080	24	2020-07-31
EMC measurement software	Rohde & Schwarz	EMC32-MEB	20090	N/A	N/A

Table 14

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment
N/A - Not Applicable

Product Service

2.5 Restricted Band Edges

2.5.1 Specification Reference

FCC 47 CFR Part 15C, ISED Canada RSS-210 and ISED Canada RSS-GEN, Clause 15.205, 4.1 and 8.10

2.5.2 Equipment Under Test and Modification State

SE1, S/N: --- - Modification State 0

2.5.3 Date of Test

2019-08-20

2.5.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 11.13.1.

Plots for average measurements were taken in accordance with ANSI C63.10 clause 4.1.4.2.3.

Final average measurements were taken in accordance with ANSI C63.10 clause 4.1.4.2.2.

2.5.5 Environmental Conditions

Ambient Temperature	22.0 °C
Relative Humidity	33.0 %

2.5.6 Test Results

DC Powered 12 V – Transmitting continuously

See chapter 2.2 for results.

FCC 47 CFR Part 15, Limit Clause 15.205

	Peak (dBµV/m)	Average (dBµV/m)
Restricted Bands of Operation	74	54

Table 15

ISED Canada RSS-GEN, Limit Clause 8.9

Frequency (MHz)	Field Strength (µV/m at 3 metres)
30-88	100
88-216	150
216-960	200
Above 960*	500

Table 16

*Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.

2.5.7 Test Location and Test Equipment Used

This test was carried out in Semi anechoic room - cabin no. 8.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Loop Antenna	Rohde & Schwarz	HFH2-Z2	18876	36	2022-08-31
TRILOG Antenna (4db)	Schwarzbeck	VULB 9162	20116	36	2022-01-31
EMI test receiver	Rohde & Schwarz	ESW26	28268	12	2020-06-30
EMC measurement software	Rohde & Schwarz	EMC32-ME+	19719	N/A	N/A

Table 17

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment
N/A - Not Applicable

Product Service

2.6 Exposure of Humans to RF Fields and SAR exclusion threshold

2.6.1 Specification Reference

IC RSS-GEN Issue 4, section 3.2 and
IC RSS-102, Issue 5, section 2.5 and
KDB 447498 D01 V06, section 4.3.1 c)

2.6.2 Guide

IC RSS-102 Issue 5, section 2.5

2.6.3 Equipment Under Test and Modification State

SE1, S/N: --- - Modification State 0

2.6.4 Date of Test

2019-08-27

2.6.5 Test Results

Product Service

Exposure of Humans to RF Fields	Applicable	Declared by applicant	Measured	Exemption
The antenna is				
☐ detachable				
The conducted output power (CP in watts) is measured at the antenna connector: CP = **..... W**			☐	
The effective isotropic radiated power (EIRP in watts) is calculated using				
☐ the numerical antenna gain: G = **.....** $EIRP = G \cdot CP \Rightarrow EIRP$ = **..... W**		☐		
☐ the field strength[1] in V/m: FS = **..... V/m** $EIRP = \frac{(FS \cdot D)^2}{30} \Rightarrow EIRP$ = **..... W**			☐	
with: Distance between the antennas in m: D = **..... m**			☐	
☒ not detachable				
A field strength measurement is used to determine the effective isotropic radiated power (EIRP in watts) given by: $EIRP = \frac{(FS \cdot D)^2}{30} \Rightarrow EIRP$ = **0.219 mW** with: Field strength in V/m: FS = **0.0081** Distance between the two antennas in m: D = **10**			☒ ☒	
Selection of output power				
The output power TP is the higher of the conducted or effective isotropic radiated power (e.i.r.p.): TP = **0.219 mW**				

[1] The conversion formula is valid only for properly matched antennas. In other cases the transmitter output power may have to be measured by a terminated measurement when applying the exemption clauses.
If an open area test site is used for field strength measurement, the effect due to the metal ground reflecting plane should be subtracted from the maximum field strength value in order to reference it to free space, before calculating TP.

Product Service

Exposure of Humans to RF Fields (continued)	Applicable	Declared by applicant	Measured	Exemption
Separation distance between the user and the transmitting device is				
☒ less than or equal to 20 cm ☐ greater than 20 cm		☐		
Transmitting device is				
☐ in the vicinity of the human head ☐ body-worn		☐		
SAR evaluation				

SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in the table.

For controlled use devices where the 8 W/kg for 1 gram of tissue applies, the exemption limits for routine evaluation in the table are multiplied by a factor of 5. For limb-worn devices where the 10 gram value applies, the exemption limits for routine evaluation in the table are multiplied by a factor of 2.5. If the operating frequency of the device is between two frequencies located in the table, linear interpolation shall be applied for the applicable separation distance. For test separation distance less than 5 mm, the exemption limits for a separation distance of 5 mm can be applied to determine if a routine evaluation is required.

For medical implants devices, the exemption limit for routine evaluation is set at 1 mW. The output power of a medical implants device is defined as the higher of the conducted or e.i.r.p to determine whether the device is exempt from the SAR evaluation.

Frequency (MHz)	Exemption limits (mW)[2] at separation distance of									
	≤5 mm	10 mm	15 mm	20 mm	25 mm	30 mm	35 mm	40 mm	45 mm	≥50 mm
≤300 [3]	71	101	132	162	193	223	254	284	315	345
450	52	70	88	106	123	141	159	177	195	213
835	17	30	42	55	67	80	92	105	117	130
1900	7	10	18	34	60	99	153	225	316	431
2450	4	7	15	30	52	83	123	173	235	309
3500	2	6	16	32	55	86	124	170	225	290
5800	1	6	15	27	41	56	71	85	97	106

Carrier frequency:	*f*	=	**21.85 kHz**	
Distance:	*d*	=	**5 mm**	
Transmitter output power:	*TP*	=	**0.219 mW**	
Limit:	TP_{limit}	=	**71 mW**	☒
☐ SAR evaluation is documented in test report no. …				

[2] The excemption limit in the table are based on measurements and simulations on half-wave dipole antennas at separaton distances of 5 mm to 25 mm from a flat phantom, providing a SAR value of approximately 0.4 W/kg for 1 g of tissue. For low frequencies (300 MHz to 835 MHz), the exemption limits are derived from alinear fit. For high frequencies (1900 MHz and above), the exemption limits are derived from athird order polynomial fit.

[3] Transmitters operating between 3 kHz and 10 MHz, meeting the exemption from routine SAR evaluation, shall demonstrate compliance to the instantaneous limits in IC RSS-102, issue 5, section 4.

Product Service

Specifications:	RSS-102, Issue 5, Section 4, Table 4, Uncontrolled Environment SPR-002, Issue 1
Operation mode:	DC Powered 12 V – Transmitting continuously
Comment:	The nerve stimulation exposure limit is defined for the frequency range 3 kHz to 10 MHz, only. Thus, the carrier at 21.85 kHz was evaluated, only.

Test procedure:	IEC 62236-1, Section 4.2 “Measurement to show accordance to the reference levels”
Test distance:	Direct contact to EUT
Limit:	*Frequency Range (MHz)* / *Electric Field (V/m_{rms})* / *Magnetic Field (A/m_{rms})* / *Peference Periode (min)* 0.003 – 10 / 83 / 90 / Instantaneous 0.1 – 10 / --- / 0.73 / f / 6 1.1 - 10 / $87/f^{0.5}$ / --- / 6 *f* in MHz
Test positions:	All surfaces: The antenna was moved all over the equipment under test using a test distance as stated above.

Measured maximum value (V/m)	*Maximum Limit at 21.85 kHz (V/m)*	*Margin to reference value (V/m)*
24.51	83.00	58.49

Measured maximum value (A/m)	*Maximum Limit at 21.85 kHz (A/m)*	*Margin to reference value (A/m)*
50.76	90.00	39.24

Measured average value (A/m)	*Average Limit at 21.85 kHz (A/m)*	*Margin to reference value (A/m)*
3.99	5.84	1.85

Product Service

SAR Exclusion threshold

Maximum Radiated Fields Strength: (see chapter 2.1.6 of this test report)	80.32 dBµV/m (at 10 m distance and 21.85 kHz)
Calculated Equivalent Radiated Power:	0.219 mW (e.i.r.p.) < 0.3 mW
Minimum separation distance:	5 mm (≤ 50 mm)
1-g numeric threshold:	(1 mW / 5 mm) · √(0.00002185 GHz) = 0.0009
1-g numeric threshold limit:	0.001

Note 1:For test distances below 5 mm according to 4.3.1 c) the test distance is fixed to 5 mm.

$$EIRP = \frac{(FS \cdot D)^2}{30}$$

2.6.6 Test Location and Test Equipment Used

This test was carried out in a non-shielded room.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Electromagnetic radiation meter	Narda Safety	EMR-200	19590	36	2019-10-31
Electric field probe	Narda Safety	Type 8.3	19591	36	2019-10-31
Magnetic field probe	Narda Safety	Type 12.1	19592	36	2019-10-31
Exposure level tester	Narda Safety	ELT-400	19725	24	2020-06-30

Table 18

Product Service

3 Measurement Uncertainty

For a 95% confidence level, the measurement uncertainties for defined systems are:

Radio Testing			
Test Name	kp	Expanded Uncertainty	Note
Occupied Bandwidth	2.0	±1.14 %	2
RF-Frequency error	1.96	±1 · 10-7	7
RF-Power, conducted carrier	2	±0.079 dB	2
RF-Power uncertainty for given BER	1.96	+0.94 dB / -1.05	7
RF power, conducted, spurious emissions	1.96	+1.4 dB / -1.6 dB	7
RF power, radiated			
25 MHz – 4 GHz	1.96	+3.6 dB / -5.2 dB	8
1 GHz – 18 GHz	1.96	+3.8 dB / -5.6 dB	8
18 GHz – 26.5 GHz	1.96	+3.4 dB / -4.5 dB	8
40 GHz – 170 GHz	1.96	+4.2 dB / -7.1 dB	8
Spectral Power Density, conducted	2.0	±0.53 dB	2
Maximum frequency deviation			
300 Hz – 6 kHz	2	±2,89 %	2
6 kHz – 25 kHz	2	±0.2 dB	2
Maximum frequency deviation for FM	2	±2,89 %	2
Adjacent channel power 25 MHz – 1 GHz	2	±2.31 %	2
Temperature	2	±0.39 K	4
(Relative) Humidity	2	±2.28 %	2
DC- and low frequency AC voltage			
DC voltage	2	±0.01 %	2
AC voltage up to 1 kHz	2	±1.2 %	2
Time	2	±0.6 %	2

Table 19

Product Service

Radio Interference Emission Testing			
Test Name	kp	Expanded Uncertainty	Note
Conducted Voltage Emission			
9 kHz to 150 kHz (50Ω/50µH AMN)	2	± 3.8 dB	1
150 kHz to 30 MHz (50Ω/50µH AMN)	2	± 3.4 dB	1
100 kHz to 200 MHz (50Ω/5µH AMN)	2	± 3.6 dB	1
Discontinuous Conducted Emission			
9 kHz to 150 kHz (50Ω/50µH AMN)	2	± 3.8 dB	1
150 kHz to 30 MHz (50Ω/50µH AMN)	2	± 3.4 dB	1
Conducted Current Emission			
9 kHz to 200 MHz	2	± 3.5 dB	1
Magnetic Fieldstrength			
9 kHz to 30 MHz (with loop antenna)	2	± 3.9 dB	1
9 kHz to 30 MHz (large-loop antenna 2 m)	2	± 3.5 dB	1
Radiated Emission			
Test distance 1 m (ALSE)			
9 kHz to 150 kHz	2	± 4.6 dB	1
150 kHz to 30 MHz	2	± 4.1 dB	1
30 MHz to 200 MHz	2	± 5.2 dB	1
200 MHz to 2 GHz	2	± 4.4 dB	1
2 GHz to 3 GHz	2	± 4.6 dB	1
Test distance 3 m			
30 MHz to 300 MHz	2	± 4.9 dB	1
300 MHz to 1 GHz	2	± 5.0 dB	1
1 GHz to 6 GHz	2	± 4.6 dB	1
Test distance 10 m			
30 MHz to 300 MHz	2	± 4.9 dB	1
300 MHz to 1 GHz	2	± 4.9 dB	1
Radio Interference Power			
30 MHz to 300 MHz	2	± 3.5 dB	1
Harmonic Current Emissions			4
Voltage Changes, Voltage Fluctuations and Flicker			4

Table 20

Immunity Testing			
Test Name	kp	Expanded Uncertainty	Note
Electrostatic Discharges			4
Radiated RF-Field			
Pre-calibrated field level	2	+32.2 / -24.3 %	5
Dynamic feedback field level	2.05	+21.2 / -17.5 %	3
Electrical Fast Transients (EFT) / Bursts			4
Surges			4
Conducted Disturbances, induced by RF-Fields			
via CDN	2	+15.1 / -13.1 %	6
via EM clamp	2	+42.6 / -29.9 %	6
via current clamp	2	+43.9 / -30.5 %	6
Power Frequency Magnetic Field	2	+20.7 / -17.1 %	2
Pulse Magnetic Field			4
Voltage Dips, Short Interruptions and Voltage Variations			4
Oscillatory Waves			4
Conducted Low Frequency Disturbances			
Voltage setting	2	± 0.9 %	2
Frequency setting	2	± 0.1 %	2
Electrical Transient Transmission in Road Vehicles			4

Table 21

Note 1:
The expanded uncertainty reported according to CISPR 16-4-2:2003-11 is based on a standard uncertainty multiplied by a coverage factor of kp = 2, providing a level of confidence of p = 95.45%
Note 2:
The expanded uncertainty reported according to UKAS Lab 34 (Edition 1, 2002-08) is based on a standard uncertainty multiplied by a coverage factor of kp = 2, providing a level of confidence of p = 95.45%
Note 3:
The expanded uncertainty reported according to UKAS Lab 34 (Edition 1, 2002-08) is based on a standard uncertainty multiplied by a coverage factor of kp = 2.05, providing a level of confidence of p = 95.45%
Note 4:
It has been demonstrated that the used test equipment meets the specified requirements in the standard with at least a 95%confidence.
Note 5:
The expanded uncertainty reported according to IEC 61000-4-3 is based on a standard uncertainty multiplied by a coverage factor of kp = 2, providing a level of confidence of p = 95.45%
Note 6:
The expanded uncertainty reported according to IEC 61000-4-6 is based on a standard uncertainty multiplied by a coverage factor of kp = 2, providing a level of confidence of p = 95.45%
Note 7:
The expanded uncertainty reported according ETSI TR 100 028 V1.4.1 (all parts) to is based on a standard uncertainty multiplied by a coverage factor of kp = 1.96, providing a level of confidence of p = 95.45%
Note 8:
The expanded uncertainty reported according to ETSI TR 102 273 V1.2.1 (all parts) is based on a standard uncertainty multiplied by a coverage factor of kp = 1.96, providing a level of confidence of p = 95.45%