Report on the FCC and IC Testing of the SKIDATA GmbH

Model: BLE

In accordance with FCC 47 CFR Part 15C and ISED Canada RSS-210, ISED Canada RSS-247 and ISED Canada RSS-GEN

Product Service

Choose certainty.
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Prepared for: SKIDATA GmbH
Untersbergstrasse 40
5083 Grödig/Salzburg
Austria

FCC ID: QSS-BLE
IC: 6215A-BLE

COMMERCIAL-IN-CONFIDENCE

Date: 2022-09-28
Document Number: TR-713268272-05 | Revision: 0

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Project Management	Patrick Müller	2022-09-28	SIGN-ID 703901
Authorised Signatory	Matthias Stumpe	2022-09-28	SIGN-ID 704030

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	Patrick Müller	2022-09-28	SIGN-ID 703902

Laboratory Accreditation	Laboratory recognition	ISED Canada test site registration
DAkkS Reg. No. D-PL-11321-11-03 DAkkS Reg. No. D-PL-11321-11-04	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-247, Issue 2 (2017-02) ISED Canada RSS-210. Issue 10 (2019-12) and ISED Canada RSS-GEN. Issue 5 (2018-04).

Trade Register Munich
HRB 85742
VAT ID No. DE129484267
Information pursuant to Section 2(1)
DL-InfoV (Germany) at
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Germany

Product Service

Contents

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	2022-09-28

Table 1

1.2 Introduction

Applicant	SKIDATA GmbH
Manufacturer	Digital Elektronik GmbH
Model Number(s)	BLE
Serial Number(s)	---
Hardware Version(s)	---
Software Version(s)	---
Number of Samples Tested	2
Test Specification/Issue/Date	FCC 47 CFR Part 15C. ISED Canada RSS-210. Issue 10 (2019-12) and ISED Canada RSS-GEN. Issue 5 (2018-04)
Test Plan/Issue/Date	---
Order Number	1078930
Date of Receipt of EUT	2022-08-08
Start of Test	2022-08-08
Finish of Test	2022-09-08
Name of Engineer(s)	Patrick Müller, Alexander Deese
Related Document(s)	ANSI C63.10 (2013)

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 and ISED Canada RSS-GEN is shown below.

Section	Specification Clause	Test Description	Result	Comments/Base Standard
Configuration and Mode: Continuously Transmitting				
3.1	15.247 (d). 15.205. B.10 and 6.13	Spurious Radiated Emissions	Pass	ANSI C63.10 (2013)
3.2	15.205 N/A and 8.10	Restricted Band Edges	Pass	ANSI C63.10 (2013)
3.3	15.247 (d). B.10 and N/A	Authorised Band Edges	Pass	ANSI C63.10 (2013)
3.4	15.247 (a)(2). N/A and 6.6	Emission Bandwidth	Pass	ANSI C63.10 (2013)
3.5	15.247 (e). N/A and 6.12	Power Spectral Density	Pass	ANSI C63.10 (2013)
3.6	15.247 (b). 5.4 and 6.12	Maximum Conducted Output Power	Pass	ANSI C63.10 (2013)
3.7	RSS-Gen. 6.11	Transmitter frequency stability	Pass	---

Table 2

Product Service

1.4 Basic information of EUT

Equipment characteristics:			
Type designation	BLE		
Type of equipment:	Bluetooth Low Energy Module		
Power supply:	☐ AC Nominal: Minimum: Maximum: Nominal frequency: Hz	☒ DC Nominal: 5V Minimum: 4.75 Maximum: 5.25	☐ Batterie Nominal:
Note for power supply:	--		
Kind of equipment:	Transceiver		
Frequency range:	2400-2483.5 MHz		
Number of RF-channels:	---		
Channel spacing	2 MHz		
Adaptive	No		
FHHS	No		
Type(s) of Modulation (e.g. BPSK. FSK. ASK. …)	As per Bluetooth 4.2 Low Energy Standard		
Type of radio transmission / Use of frequency spectrum (e.g. DSSS. OFDM..)	As per Bluetooth 4.2 Low Energy Standard		
Number / Type of Antenna(s)	Integral Antenna		
Antenna Gain:	2 dBi		
Temperature Range:	-30°C – 85°C		

Product Service

1.5 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 (radiated sample) SN: Prototype	Not Applicable	Not Applicable

Table 3

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
0	As supplied by the customer (Conducted Sample) SN: Prototype	Not Applicable	Not Applicable

Table 4

1.6 Test Location

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

Test Name	Name of Engineer(s)
Configuration and Mode: Continuously Transmitting	
Spurious Radiated Emissions	Patrick Müller
Restricted Band Edges	Patrick Müller, Alexander Deese
Authorised Band Edges	Patrick Müller, Alexander Deese
Emission Bandwidth	Patrick Müller, Alexander Deese
Power Spectral Density	Patrick Müller, Alexander Deese
Maximum Conducted Output Power	Patrick Müller, Alexander Deese
Transmitter frequency stability	Patrick Müller, Alexander Deese

Table 5

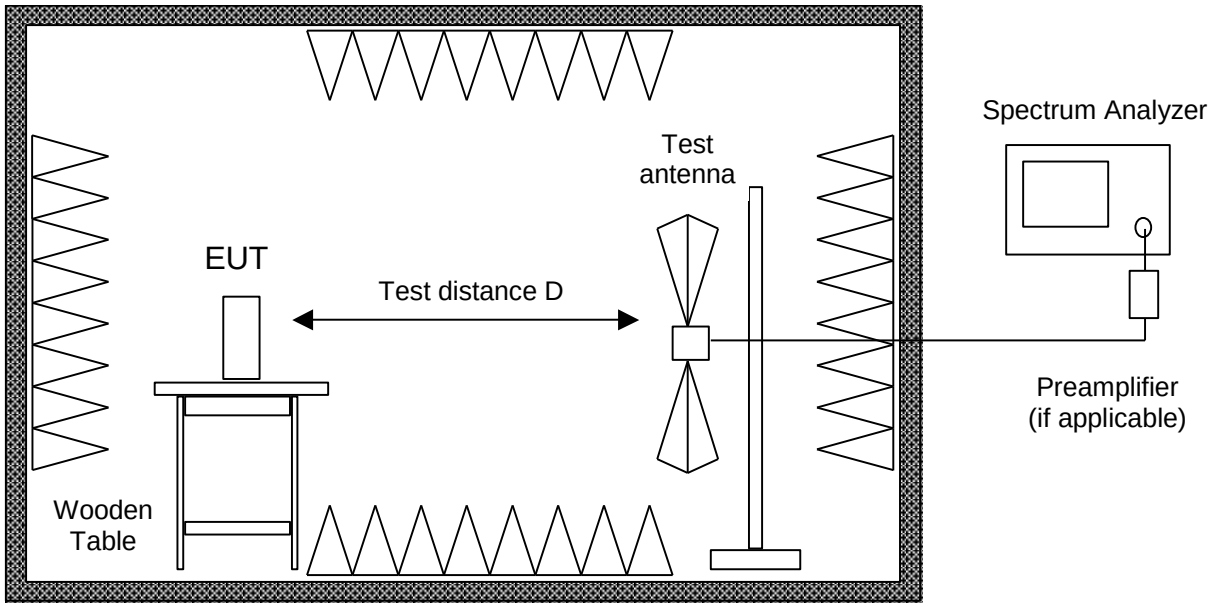
Office Address:

Äußere Frühlingstraße 45
94315 Straubing
Germany

Product Service

2 Test Setup

2.1 Radiated Emission in Fully or Semi Anechoic Room



Fully or semi anechoic room

Radiated emission in fully or semi anechoic room is measured in the frequency range from 30 MHz to the maximum frequency as specified in CFR 47 Part 15 section 15.33.

Measurements are made in both the horizontal and vertical planes of polarization using a spectrum analyzer with the detector function set to peak and resolution as well as video bandwidth set to 100 kHz (below 1 GHz) or 1 MHz (above 1 GHz).

Testing up to 1 GHz is performed with a linear polarized logarithmic periodic antenna combined with a 4:1 broadband dipole ("Trilog broadband antenna"). For testing above 1 GHz horn antennas are used.

All tests below 8.2 GHz are performed at a test distance D of 3 meters. For higher frequencies the test distance may be reduced (e.g. to 1 meter) due to the sensitivity of the measuring instrument(s) and the test results are calculated according to CFR 47 Part 15 section 15.31(f)(1) using an extrapolation factor of 20 dB/decade. If required. preamplifiers are used for the whole frequency range. Special care is taken to avoid overload. using appropriate attenuators and filters. if necessary.

If the radiated emission limits are expressed in terms of the average value of the emission there also is a peak limit corresponding to 20 dB above the maximum permitted average limit. Additionally. if pulsed operation is employed. the average field strength is determined by averaging over one complete pulse train. including blanking intervals. as specified in CFR 47 Part 15 section 15.35(c). If the pulse train exceeds 0.1 second that 0.1 second interval during which the value of the emission is at its maximum is selected for calculation. The pulse train correction is added to the peak value of the emission to get the average value.

Hand-held or body-worn devices are rotated through three orthogonal axes to determine which attitude and configuration produces the highest emission relative to the limit and therefore shall be used for final testing.

During testing the EUT is rotated all around to find the maximum levels of emissions. Equipment and cables are placed and moved within the range of position likely to find their maximum emissions.

For final testing below 1 GHz a semi anechoic room complying with the NSA requirements of ANSI C63.4 for alternative test sites is used (see 2.2). If prescans are recorded in fully anechoic room they are indicated appropriately.

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According to section 13 of KDB558074 the requirement for radiated emissions on the band edges was performed with a reduced bandwidth of 100 kHz instead of 1 MHz.

Radiated emission in the frequency range 9 kHz to 30 MHz is measured using an active loop antenna. First the whole spectrum of emission caused by the equipment is recorded at a distance of 3 meters in a fully or semi anechoic room with the detector of the spectrum analyzer or EMI receiver set to peak. This configuration is also used for recording the spectrum of intentional radiators.

Hand-held or body-worn devices are rotated through three orthogonal axes to determine which attitude and configuration produces the highest emission relative to the limit and therefore shall be used for final testing.

EUT is rotated all around to find the maximum levels of emissions. Equipment and cables are placed and moved within the range of position likely to find their maximum emissions.
If worst case emission of the EUT cannot be recorded with EUT in standard position and loop antenna in vertical polarization the EUT (or the radiating part of the EUT) is rotated by 90 degrees instead of changing the loop antenna to horizontal polarization. This procedure is selected to minimize the influence of the environment (e.g. effects caused by the floor especially with longer distances).

Final measurement is performed at a test distance D of 30 meters using an open field test site. In case the regulation requires testing at other distances. the result is extrapolated by either making measurements at an additional distance D of 10 meters to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade). In cases of very low emissions measurements are performed at shorter distances and results are extrapolated to the required distance. The provisions of CFR 47 Part 15 sections 15.31(d) and (f)(2) apply. According to CFR 47 Part 15 section 15.209(d) final measurement is performed with detector function set to quasi-peak except for the frequency bands 9 to 90 kHz and 110 to 490 kHz where. for non-pulsed operation. average detector is employed.

If the radiated emission limits are expressed in terms of the average value of the emission there also is a peak limit corresponding to 20 dB above the maximum permitted average limit. Additionally. if pulsed operation is employed. the average field strength is determined by averaging over one complete pulse train. including blanking intervals. as specified in CFR 47 Part 15 section 15.35(c). If the pulse train exceeds 0.1 second that 0.1 second interval during which the value of the emission is at its maximum is selected for calculation. The pulse train correction is added to the peak value of the emission to get the average value.

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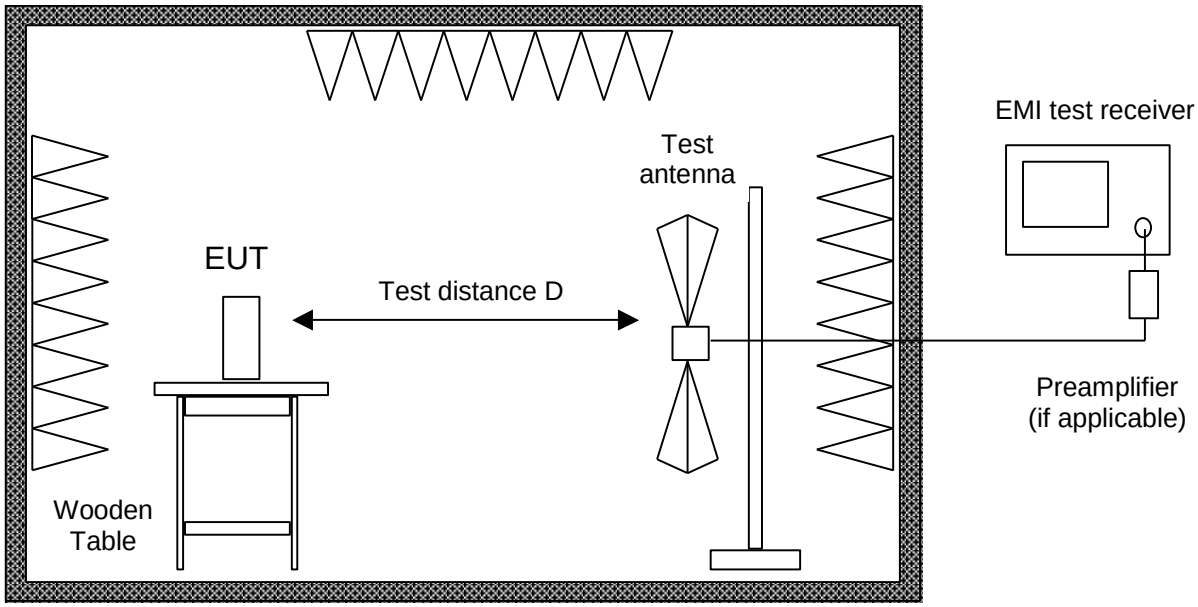
2.2 Radiated Emission at Alternative Test Site



Alternate test site (semi anechoic room)

Radiated emission in the frequency range 30 MHz to 1 GHz is measured within a semi-anechoic room with groundplane complying with the NSA requirements of ANSI C63.4 for alternative test sites. A linear polarized logarithmic periodic antenna combined with a 4:1 broadband dipole ("Trilog broadband antenna") is used. The measurement bandwidth of the test receiver is set to 120 kHz with quasi-peak detector selected.

If the radiated emission limits are expressed in terms of the average value of the emission there also is a peak limit corresponding to 20 dB above the maximum permitted average limit. Additionally. if pulsed operation is employed. the average field strength is determined by averaging over one complete pulse train. including blanking intervals. as specified in CFR 47 Part 15 section 15.35(c). If the pulse train exceeds 0.1 second that 0.1 second interval during which the value of the emission is at its maximum is selected for calculation. The pulse train correction is added to the peak value of the emission to get the average value.

Hand-held or body-worn devices are tested in the position producing the highest emission relative to the limit as verified by prescans in fully anechoic room.

If no prescan in a fully anechoic room is used first a peak scan is performed in four positions to get the whole spectrum of emission caused by EUT with the measuring antenna raised and lowered from 1 to 4 m to find table position. antenna height and antenna polarization for the maximum emission levels. Data reduction is applied to these results to select those levels having less margin than 10 dB to or exceeding the limit using subranges and limited number of maximums. Further maximization is following.
With detector of the test receiver set to quasi-peak final measurements are performed immediately after frequency zoom (for drifting disturbances) and maximum adjustment.
Equipment and cables are placed and moved within the range of position likely to find their maximum emissions.

In cases where prescans in a fully anechoic room are taken (e. g. if EUT is operating for a short time only or battery is dircharged quickly) final measurements with quasi-peak detector are performed manually at frequencies indicated by prescan with EUT rotating all around and receiving antenna raising and lowering within 1 meter to 4 meters to find the maximum levels of emission.
Equipment and cables are placed and moved within the range of position likely to find their maximum emissions.

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For measuring emissions of intentional radiators and receivers a test distance D of 3 meters is selected. Testing of unintentional radiators is performed at a distance of 10 meters. If limits specified for 3 meters shall be used for measurements performed at 10 meters distance the limits are calculated according to CFR 47 Part 15 section 15.31(d) and (f)(1) using an inverse linear-distance extrapolation factor of 20 dB/decade.

Product Service

3 Test Details

3.1 Spurious Emissions

3.1.1 Specification Reference

FCC 47 CFR Part 15C, ISED Canada RSS-210 and ISED Canada RSS-GEN

3.1.2 Equipment Under Test and Modification State

BLE (radiated sample). S/N: --- - Modification State 0

3.1.3 Date of Test

2022-09-01 – 2022-09-08

3.1.4 Test Method

Plots for average measurements were taken in accordance with ANSI C63.10-2013 clause 4.1.4.2.3 to characterize the EUT. Where emissions were detected. final average measurements were taken in accordance with ANSI C63.10-2013 clause 4.1.4.2.2.

The plots shown are the characterization of the EUT. The limits on the plots represent the most stringent case for restricted bands. (54/74 dBuV/m) when compared to 20 dBc outside restricted bands. The limits shown have been used as a threshold to determine where further measurements are necessary. Where results are within 10 dB of the limits shown on the plots. further investigation was carried out and reported in results tables.

The following conversion can be applied to convert from dBµV/m to µV/m:
10^(Field Strength in dBµV/m/20).

3.1.5 Environmental Conditions

Ambient Temperature	24.0 °C
Relative Humidity	45.0 %

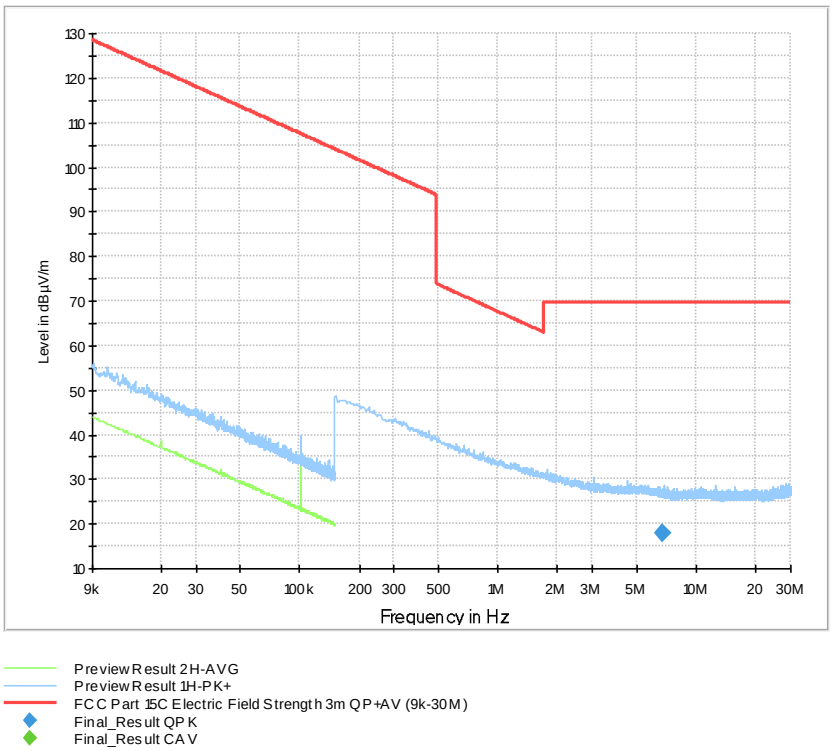
3.1.6 Test Results

Sample calculation of final values:

Final Value (dBµV/m) = Reading Value (dBµV) + Cable Correction Factor (dB)
+ Antenna Correction Factor (dB/m)
+ Pulse Train Correction (dB)

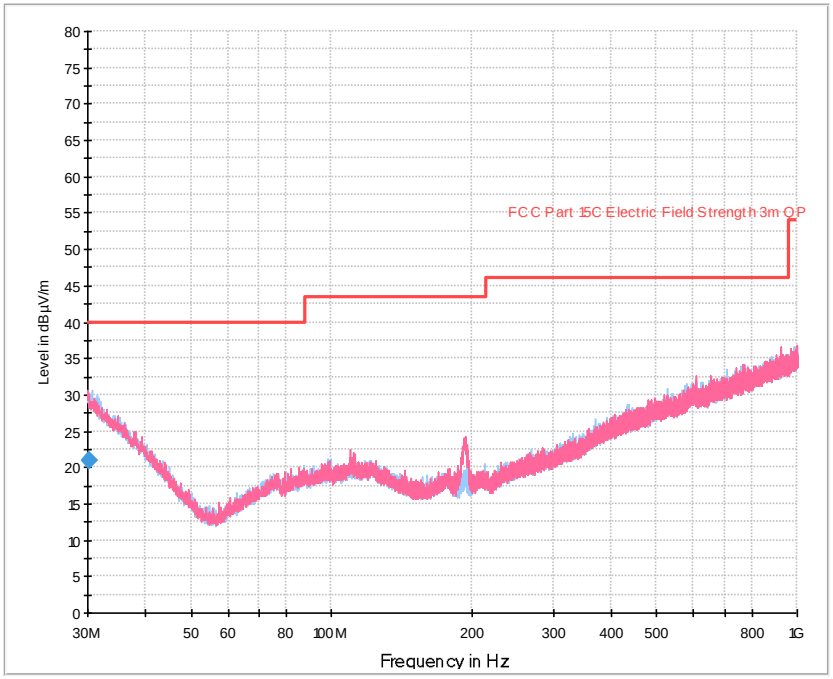
Product Service

Transmission on 2402 MHz, radiated measurement:



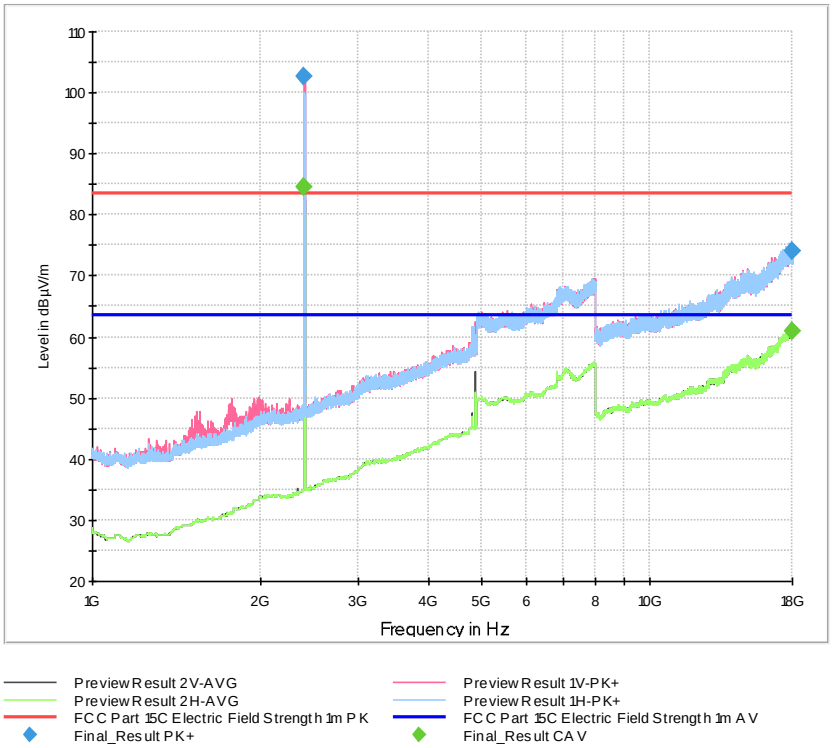
Final Results:

Frequency *MHz*	*QuasiPeak* *dBµV/m*	*CAverage* *dBµV/m*	*Limit* *dBµV/m*	*Margin* *dB*	*Meas. Time* *ms*	*Bandwidth* *kHz*	*Height* *cm*	*Pol*	*Azimuth* *deg*	*Corr.* *dB*
6.828000	18.02	---	69.54	51.52	1000.0	9.000	100.0	H	-48.0	19.2



Final Results:

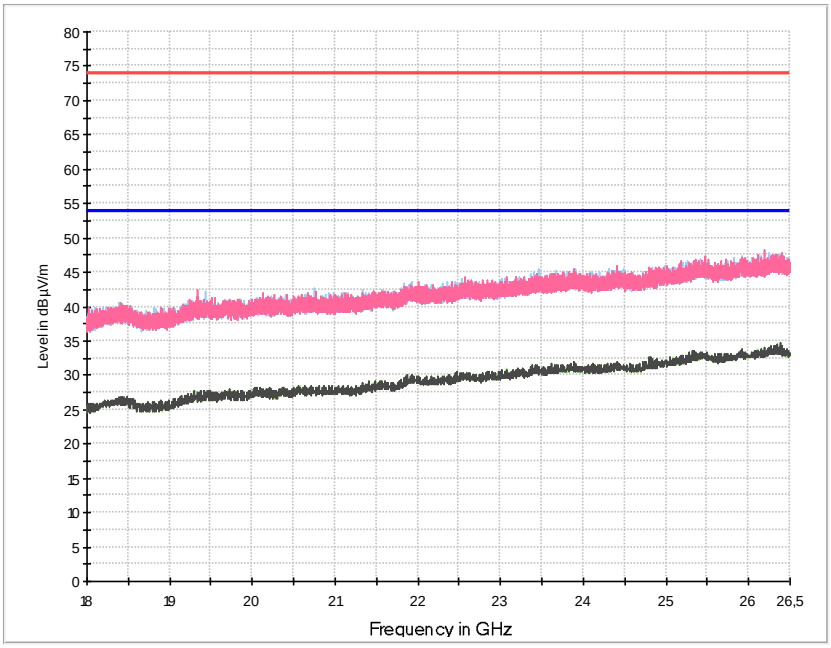
er *MHz*	*QuasiPeak* *dBµV/m*	*Limit* *dBµV/m*	*Margin* *dB*	*Meas. Time* *ms*	*Bandwidth* *kHz*	*Height* *cm*	*Pol*	*Azimuth* *deg*	*Corr.* *dB/m*
30.120000	20.87	40.00	19.13	1000.0	120.000	192.0	H	-56.0	25.3



Final Results:

Frequency *MHz*	*MaxPeak* *dBµV/m*	*CAverage* *dBµV/m*	*Limit* *dBµV/m*	*Margin* *dB*	*Meas. Time* *ms*	*Bandwidth* *kHz*	*Height* *cm*	*Pol*	*Azimuth* *deg*	*Corr.* *dB*
2401.750000	102.61	---	#1	#1	1000.0	1000.000	200.0	V	168.0	34.0
2401.750000	---	84.43	#1	#1	1000.0	1000.000	200.0	V	168.0	34.0
18000.000000	74.10	---	83.50	9.40	1000.0	1000.000	100.0	V	-60.0	59.3
18000.000000	---	61.02	63.50	2.48	1000.0	1000.000	100.0	V	-60.0	59.3

#1: intentional radiation


Level in dBµV/m
Frequency in GHz
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
18
19
20
21
22
23
24
25
26
26,5
Preview Result 2H-AVG
Preview Result 2V-AVG
FCC Part 15C Electric Field Strength 3m PK
Final_Result PK+
Preview Result 1H-PK+
Preview Result 1V-PK+
FCC Part 15C Electric Field Strength 3m AV
Final_Result CAV

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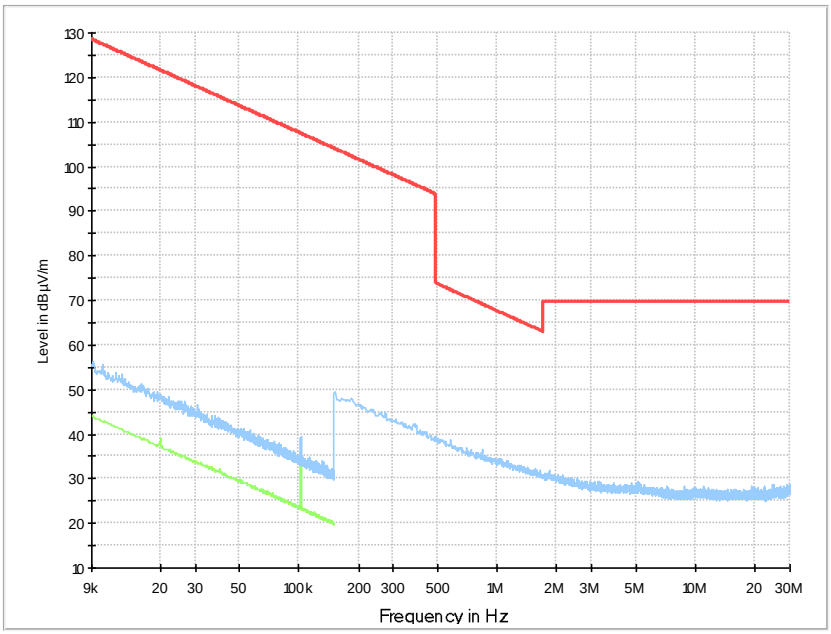
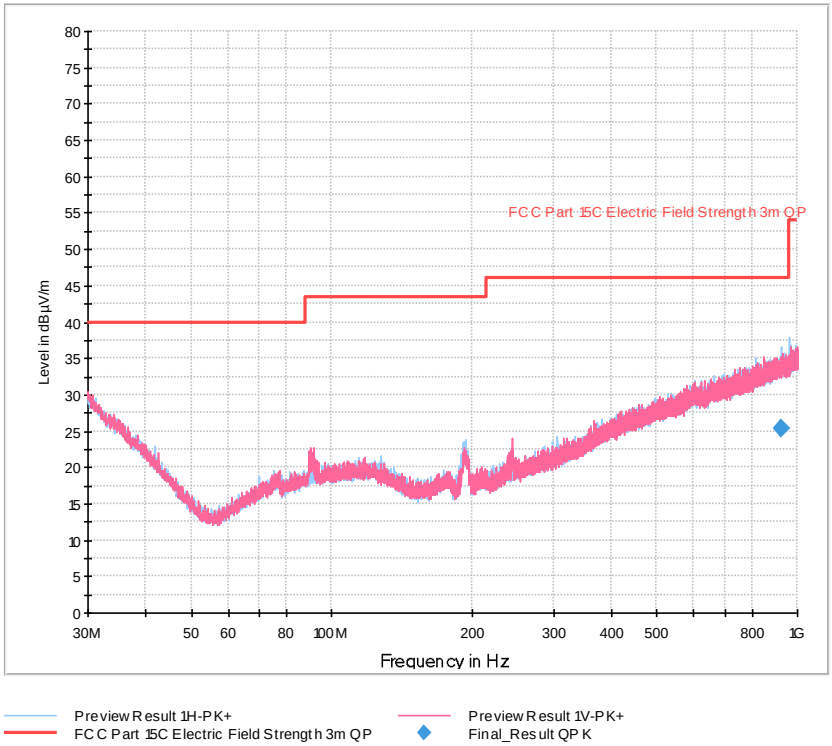
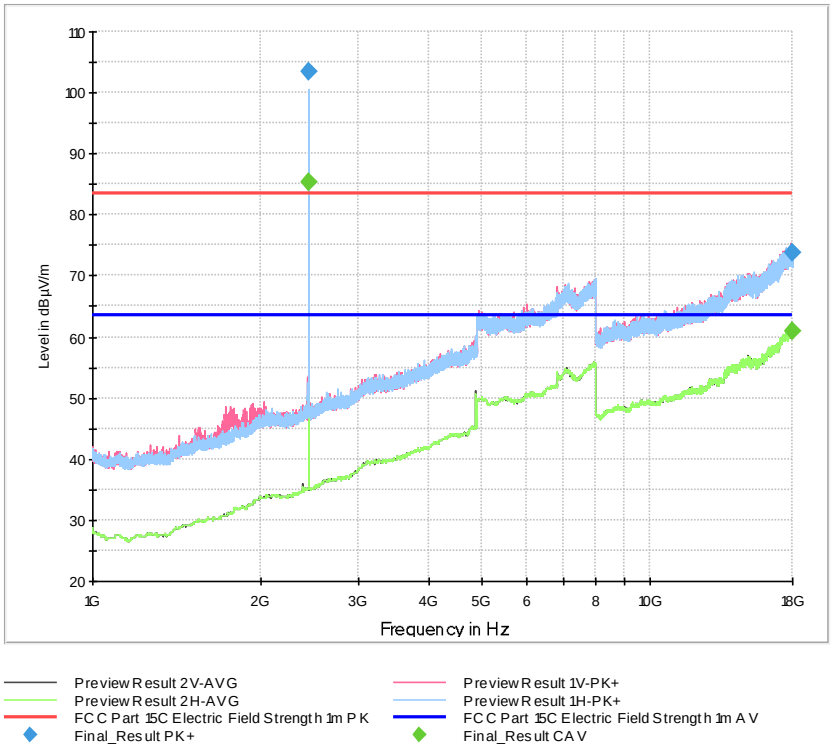
Transmission on 2440 MHz. radiated measurement:





Final Results:

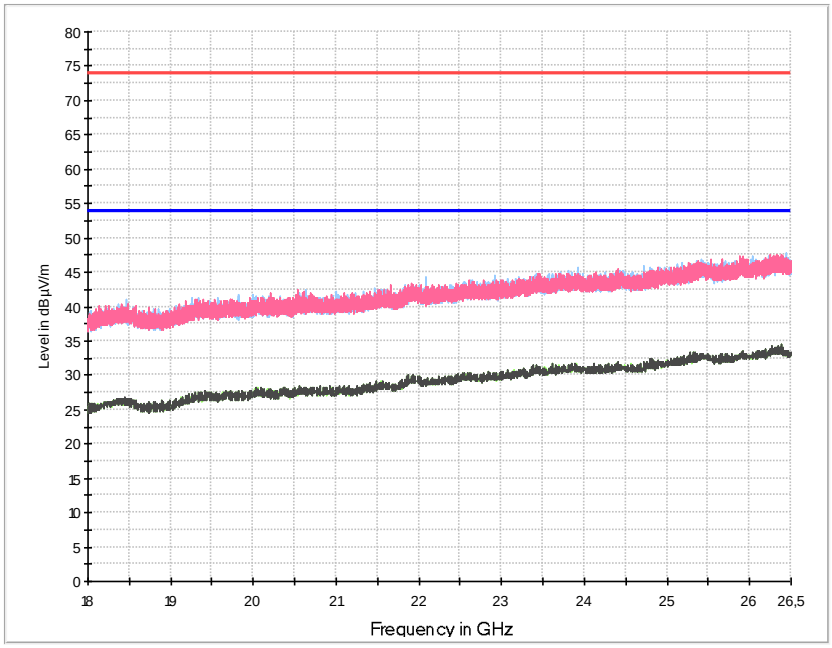
Frequency *MHz*	*QuasiPeak* *dBµV/m*	*Limit* *dBµV/m*	*Margin* *dB*	*Meas. Time* *ms*	*Bandwidth* *kHz*	*Height* *cm*	*Pol*	*Azimuth* *deg*	*Corr.* *dB/m*
925.050000	25.39	46.02	20.63	1000.0	120.000	100.0	H	96.0	31.1



Final Results:

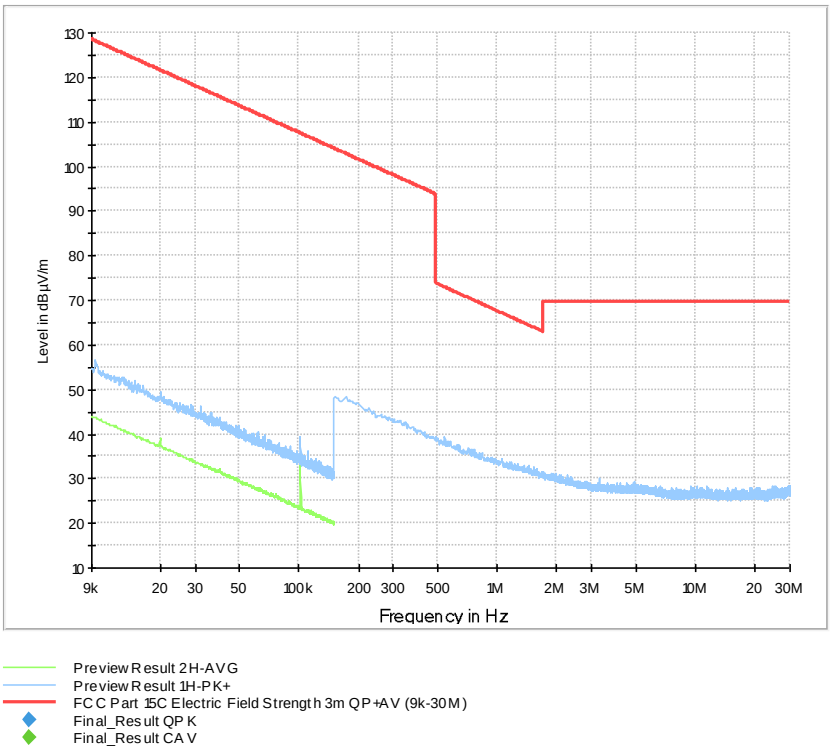
Frequency *MHz*	*MaxPeak* *dBµV/m*	*CAverage* *dBµV/m*	*Limit* *dBµV/m*	*Margin* *dB*	*Meas. Time* *ms*	*Bandwidth* *kHz*	*Height* *cm*	*Pol*	*Azimuth* *deg*	*Corr.* *dB*
2439.750000	103.44	---	#1	#1	1000.0	1000.000	175.0	V	-116.0	34.0
2439.750000	---	85.22	#1	#1	1000.0	1000.000	175.0	V	-116.0	34.0
17995.500000	73.76	---	83.50	9.74	1000.0	1000.000	125.0	H	-149.0	59.3
17995.500000	---	60.98	63.50	2.52	1000.0	1000.000	125.0	H	-149.0	59.3

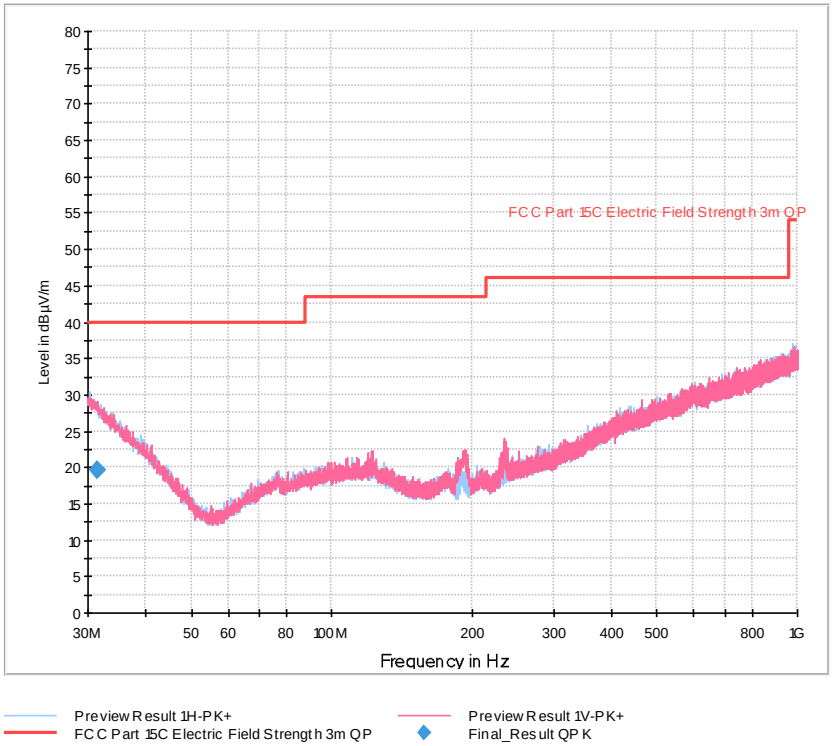
#1: intentional radiation


Level in dBµV/m
Frequency in GHz
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
18
19
20
21
22
23
24
25
26
26,5
Preview Result 2H-AVG
Preview Result 2V-AVG
FCC Part 15C Electric Field Strength 3m PK
Final_Result PK+
Preview Result 1H-PK+
Preview Result 1V-PK+
FCC Part 15C Electric Field Strength 3m AV
Final_Result CAV

Product Service

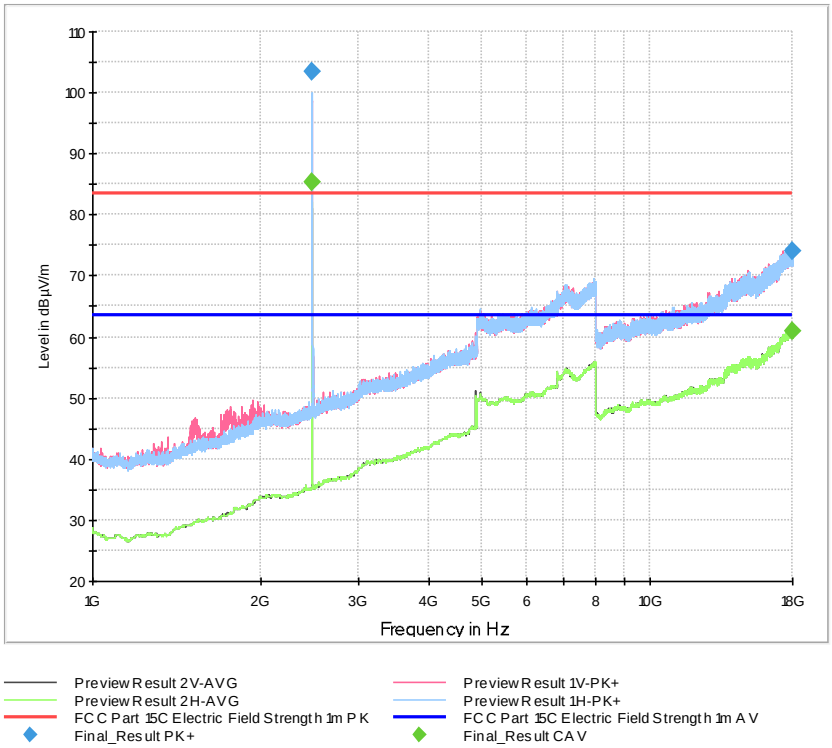
Transmission on 2480 MHz. radiated measurement:





Final Results:

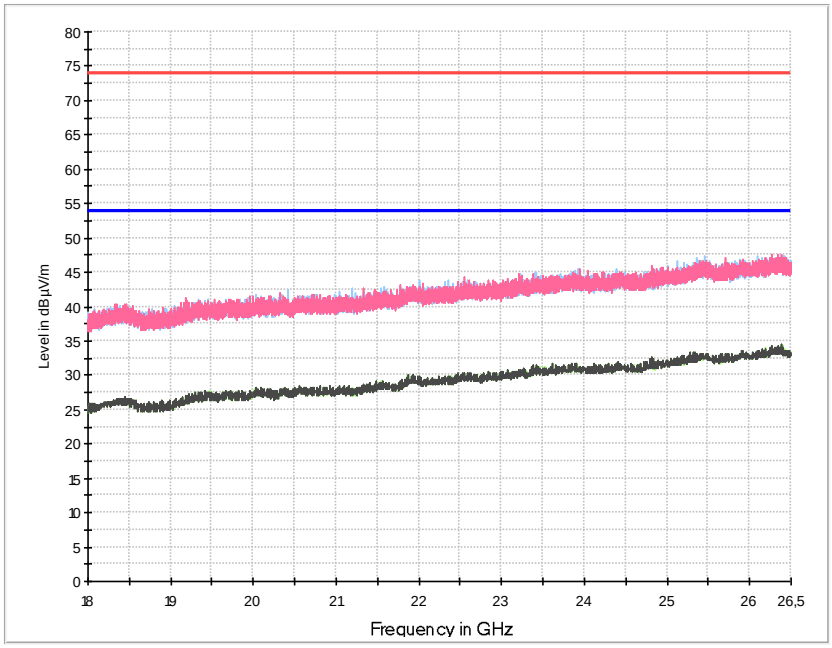
Frequency *MHz*	*QuasiPeak* *dBµV/m*	*Limit* *dBµV/m*	*Margin* *dB*	*Meas. Time* *ms*	*Bandwidth* *kHz*	*Height* *cm*	*Pol*	*Azimuth* *deg*	*Corr.* *dB/m*
31.350000	19.60	40.00	20.40	1000.0	120.000	339.0	H	-116.0	24.6



Final Results :

Frequency *MHz*	*MaxPeak* *dBµV/m*	*CAverage* *dBµV/m*	*Limit* *dBµV/m*	*Margin* *dB*	*Meas. Time* *ms*	*Bandwidth* *kHz*	*Height* *cm*	*Pol*	*Azimuth* *deg*	*Corr.* *dB*
2479.750000	103.51	---	#1	#1	1000.0	1000.000	100.0	H	167.0	34.2
2479.750000	---	85.29	#1	#1	1000.0	1000.000	100.0	H	167.0	34.2
17997.000000	74.13	---	83.50	9.37	1000.0	1000.000	220.0	V	-83.0	59.3
17997.000000	---	61.03	63.50	2.47	1000.0	1000.000	220.0	V	-83.0	59.3

#1: Intentional radiation



Preview Result 2H-AVG
Preview Result 2V-AVG
FCC Part 15C Electric Field Strength 3m PK
Final_Result PK+
Preview Result 1H-PK+
Preview Result 1V-PK+
FCC Part 15C Electric Field Strength 3m AV
Final_Result CAV

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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
1705 to 30	30	30
30 to 88	100**	3
88 to 216	150**	3
216 to 960	200**	3
Above 960	500	5

ISED Canada RSS-210

Frequency	Electric Field Strength (µV/m)	Magnetic Field Strength (H-Field) (µA/m)	Measurement Distance (m)
9 - 490 kHz	2.400/F (F in kHz)	2.400/377F (F in kHz)	300
490 - 1.705 kHz	24.000/F (F in kHz)	24.000/377F (F in kHz)	30
1.705 kHz - 30 MHz	30	N/A	30

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

Product Service

3.1.7 Test Location and Test Equipment Used

Radiated Tests were carried out in cabin No. 11.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
EMI test receiver	Rohde & Schwarz	ESW44	39897	12	2023-04-30
Double ridged horn antenna	Rohde & Schwarz	HF907	40089	24	2023-02-28
Loop antenna	Schwarzbeck	FMZB 1519 B	44334	36	2023-01-31
ULTRALOG Antenna	Rohde & Schwarz	HL562E	39969	36	2022-11-30
Horn Antenna with preamplifier	Rohde & Schwarz	A-INFOMW LB-180400H-KF+ TS-	43661	12	2022-12-31
EMC measurement software	Rohde & Schwarz	EMC32 Emission K11 - V10.50.10	42986	---	---
Semi Anechoic Room	Frankonia	Cabin No. 11	42961	36	2024-09-30

Table 6

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

Product Service

3.2 Restricted Band Edges

3.2.1 Specification Reference

FCC 47 CFR Part 15C. ISED Canada RSS-210 and ISED Canada RSS-GEN

3.2.2 Equipment Under Test and Modification State

BLE. S/N: --- - Modification State 0

3.2.3 Date of Test

2022-09-08

3.2.4 Test Method

This test was performed in accordance with ANSI C63.10. clause 6.10.5.

Plots for average measurements were taken in accordance with ANSI C63.10 clause 4.1.4.2.3. These are shown for information purposes and were used to determine the worst case measurement point. Final average measurements were then taken in accordance with ANSI C63.10 clause 4.1.4.2.2. to obtain the measurement result recorded in the test results tables.

The following conversion can be applied to convert from dBµV/m to µV/m:
10^(Field Strength in dBµV/m/20).

3.2.5 Environmental Conditions

Ambient Temperature	22.0 °C
Relative Humidity	35.0 %

3.2.6 Test Results

Results are shown in chapter 3.3

FCC 47 CFR Part 15. Limit Clause 15.209

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

Table 7

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 8

*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.

Product Service

3.2.7 Test Location and Test Equipment Used

Radiated Tests were carried out in cabin No. 11 and conducted tests were carried out with test system TS8997.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Trilog Antenna	Schwarzbeck	VULB9162	20116	36	2025-01-31
EMI test receiver	Rohde & Schwarz	ESW44	39897	12	2023-04-30
Double ridged horn antenna	Rohde & Schwarz	HF907	40089	24	2023-02-28
Loop antenna	Schwarzbeck	FMZB 1519 B	44334	36	2023-01-31
ULTRALOG Antenna	Rohde & Schwarz	HL562E	39969	36	2022-11-30
Horn Antenna with preamplifier	Rohde & Schwarz	A-INFOMW LB-180400H-KF+ TS-	43661	12	2022-12-31
EMC measurement software	Rohde & Schwarz	EMC32 Emission K11 - V10.50.10	42986	---	---
Semi Anechoic Room	Frankonia	Cabin No. 11	42961	36	2024-08-31
Spectrum Analyzer	Rohde & Schwarz	FSV40	20219	12	2024-02-29
Vector Signal Generator	Rohde & Schwarz	SMBV100A	20238	36	2022-11-30
Signal Generator	Rohde & Schwarz	SMB100A	20215	36	2023-12-31
Switching Device	Rohde & Schwarz	OSP120 I	20248	24	2023-02-28
Switching Device	Rohde & Schwarz	OSP120 II	38807	36	2023-11-30
EMC Measurement Software	Rohde & Schwarz	EMC32 TS8997 - V10.50.00	44381	---	---

Table 9

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

Product Service

3.3 Authorised Band Edges

3.3.1 Specification Reference

FCC 47 CFR Part 15C, ISED Canada RSS-210 and ISED Canada RSS-GEN

3.3.2 Equipment Under Test and Modification State

BLE (conducted sample). S/N: --- - Modification State 0

3.3.3 Date of Test

2022-09-08

3.3.4 Test Method

Test according to FCC title 47 part 15 §15.247(d). KDB 558074 D01 DTS Meas. Guidance v05 8.7 and ANSI C63.10-2013

3.3.5 Environmental Conditions

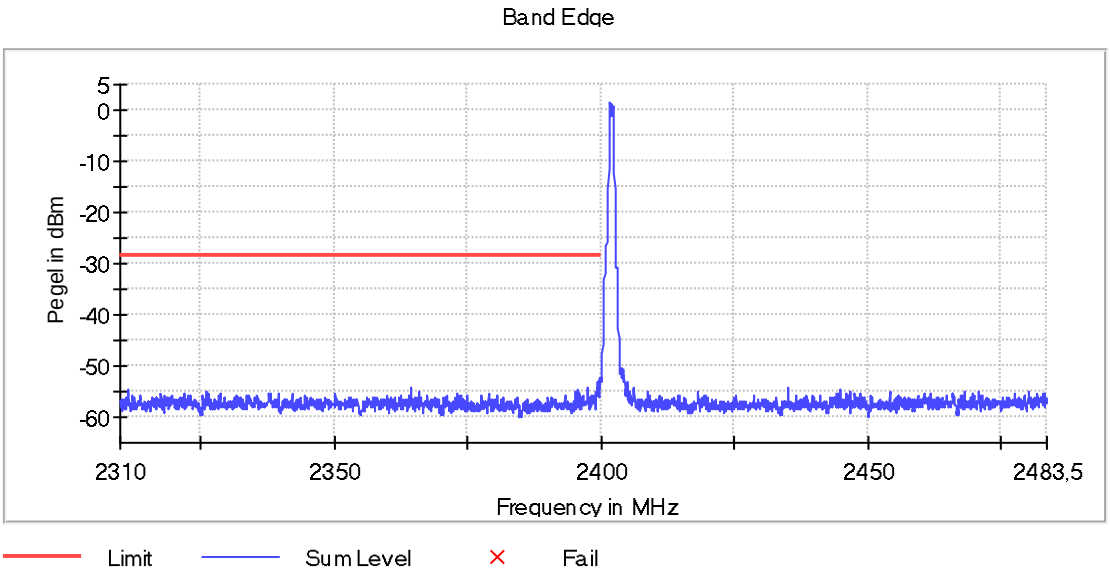
Ambient Temperature	22.0 °C
Relative Humidity	35.0 %

3.3.6 Test Results

Product Service

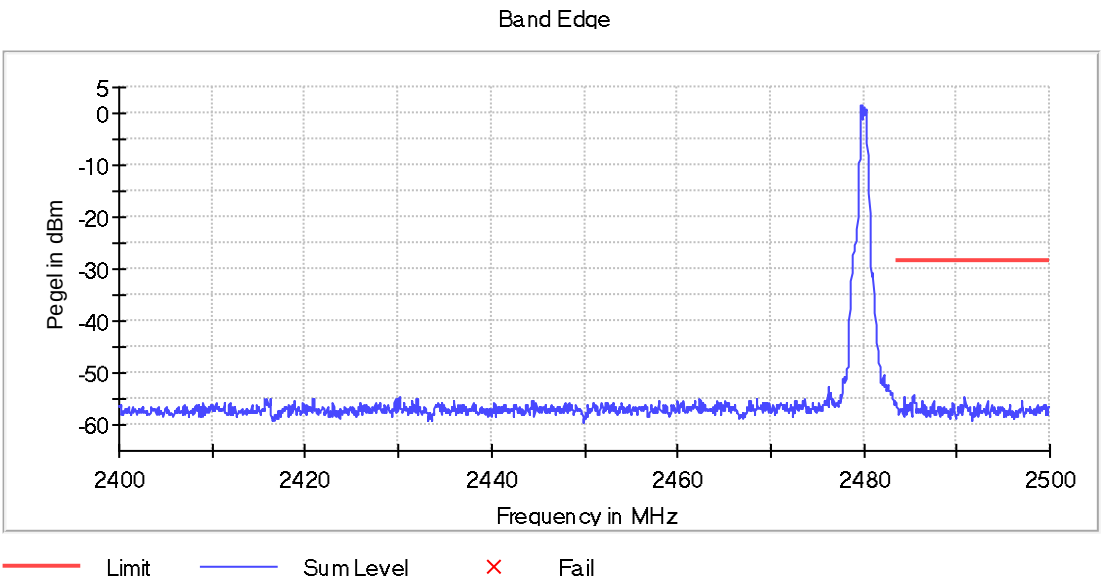
Transmission on 2402 MHz

Band Edge Low



Transmission on 2480 MHz

Band Edge High



FCC 47 CFR Part 15. Limit Clause 15.247 (d)

20 dB below the fundamental measured in a 100 kHz bandwidth using a peak detector. If the transmitter complies with the conducted power limits. based on the use of RMS averaging over a time interval. the attenuation required shall be 30 dB below the fundamental instead of 20 dB.

3.3.7 Test Location and Test Equipment Used

Conducted test was carried out in Non-shielded room with Test system TS8997.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Spectrum Analyzer	Rohde & Schwarz	FSV40	20219	12	2024-02-29
Vector Signal Generator	Rohde & Schwarz	SMBV100A	20238	36	2022-11-30
Signal Generator	Rohde & Schwarz	SMB100A	20215	36	2023-12-31
Switching Device	Rohde & Schwarz	OSP120 I	20248	24	2023-02-28
Switching Device	Rohde & Schwarz	OSP120 II	38807	36	2023-11-30
EMC Measurement Software	Rohde & Schwarz	EMC32 TS8997 - V10.50.00	44381	---	---

Table 10

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

Product Service

3.4 Emission Bandwidth

3.4.1 Specification Reference

FCC 47 CFR Part 15C. ISED Canada RSS-210 and ISED Canada RSS-GEN

3.4.2 Equipment Under Test and Modification State

BLE (conducted sample). S/N: --- - Modification State 0

3.4.3 Date of Test

2022-09-08

3.4.4 Test Method

Test according to FCC title 47 part 15 §15.247(a). KDB 558074 D01 DTS Meas Guidance v05 and ANSI C63.10-2013 11.8.1

3.4.5 Environmental Conditions

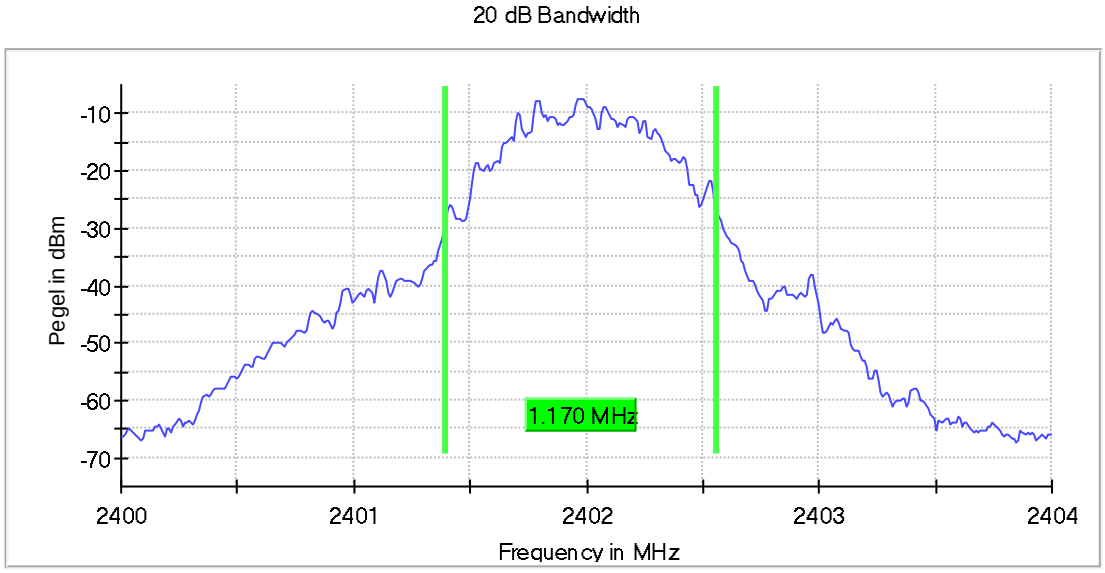
Ambient Temperature	22.0 °C
Relative Humidity	35.0 %

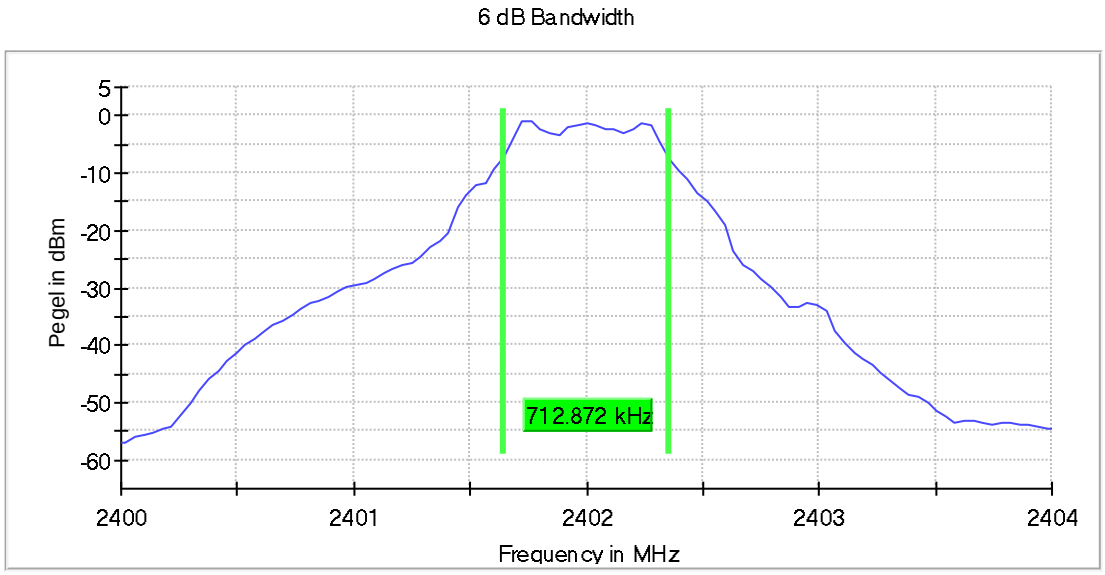
3.4.6 Test Results

Frequency (MHz)	20 dB Bandwidth (MHz)	6 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)	Limit
2402	1.170	0.713	1.020	≥ 500 kHz
2440	1.170	0.713	1.010	≥ 500 kHz
2480	1.160	0.713	1.020	≥ 500 kHz

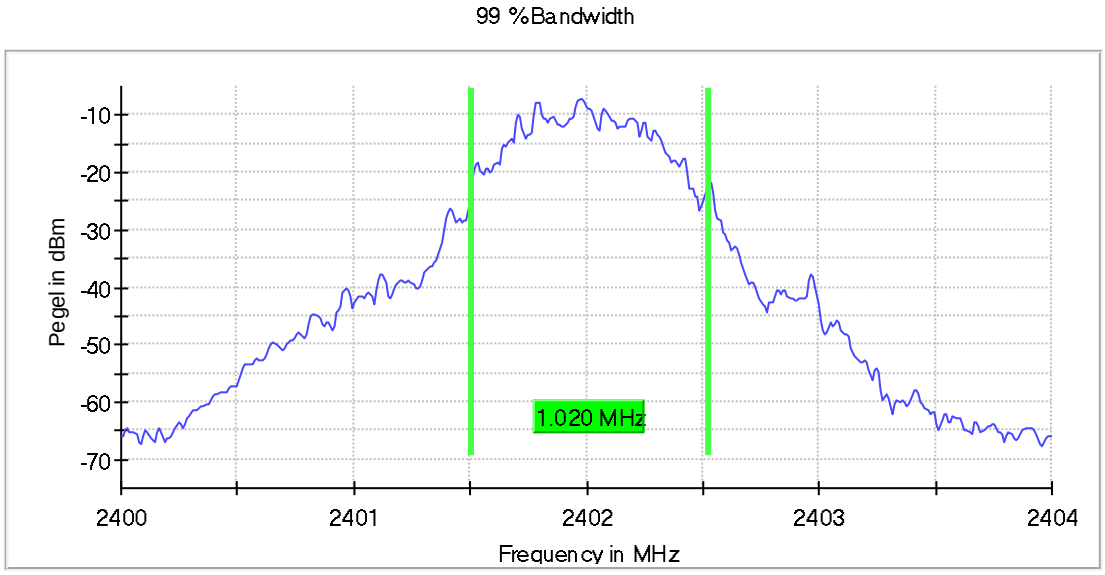
Product Service

Transmission on 2402 MHz

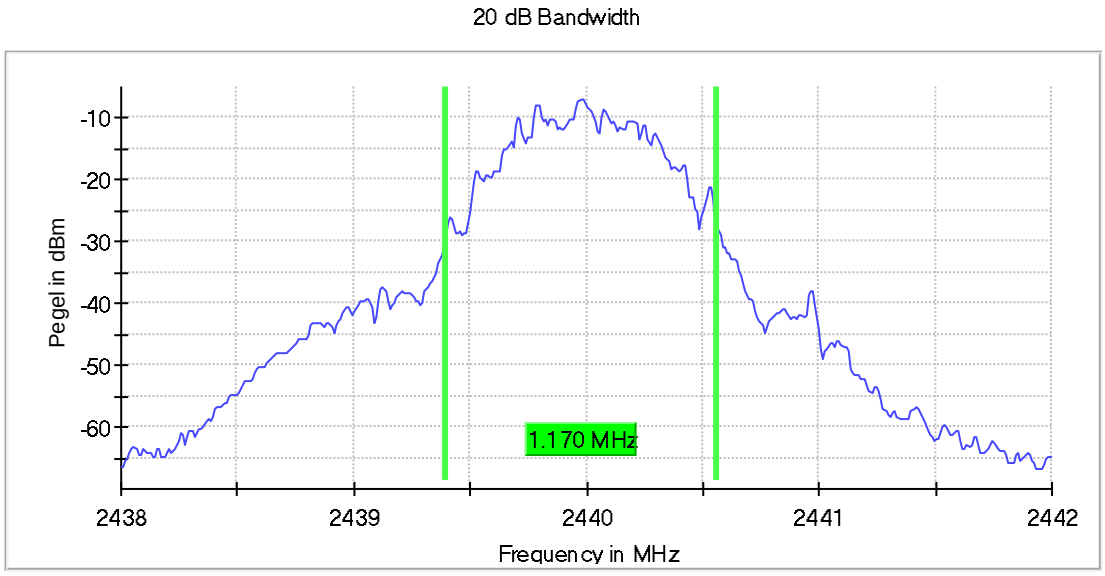




Product Service

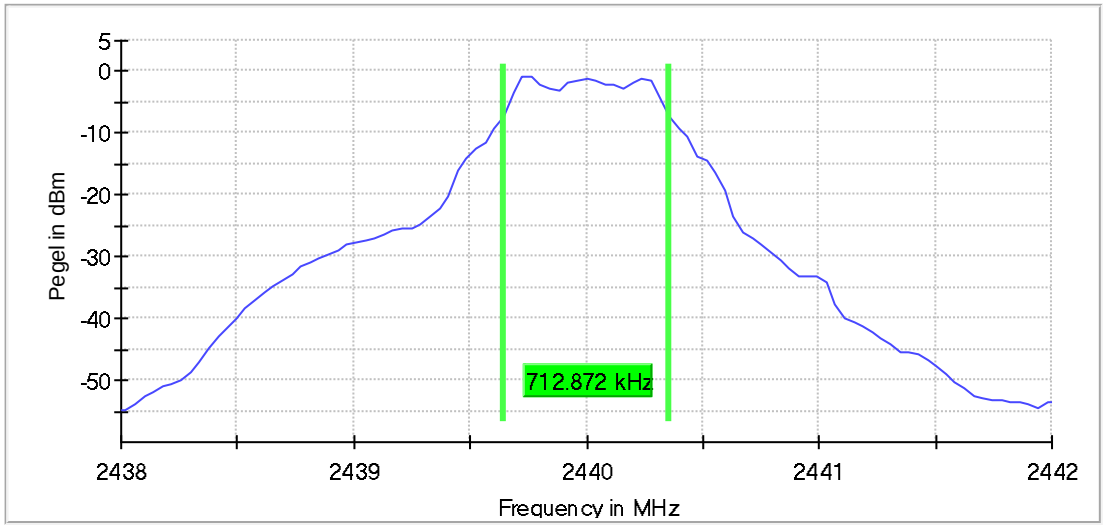


Transmission on 2440 MHz

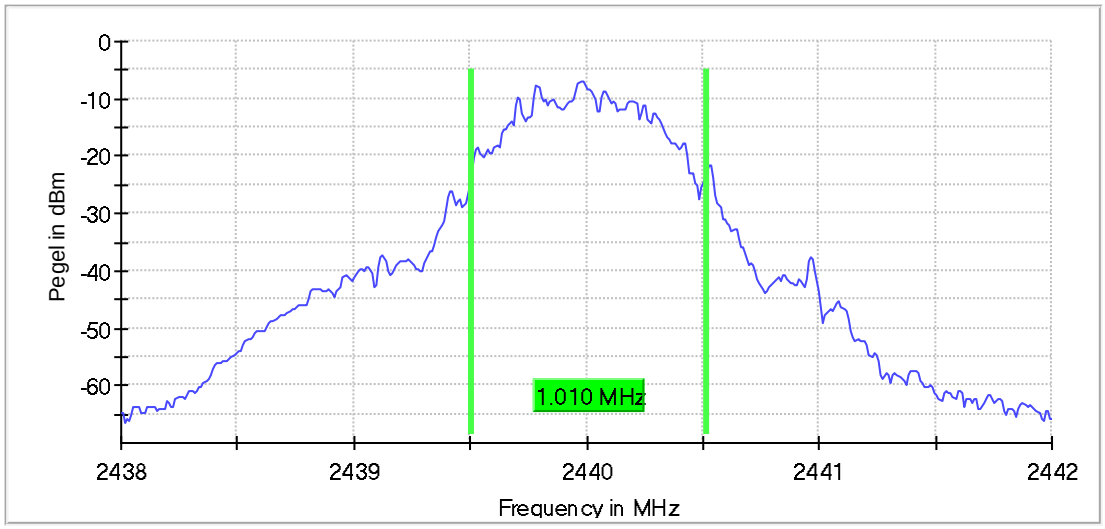


Product Service

6 dB Bandwidth



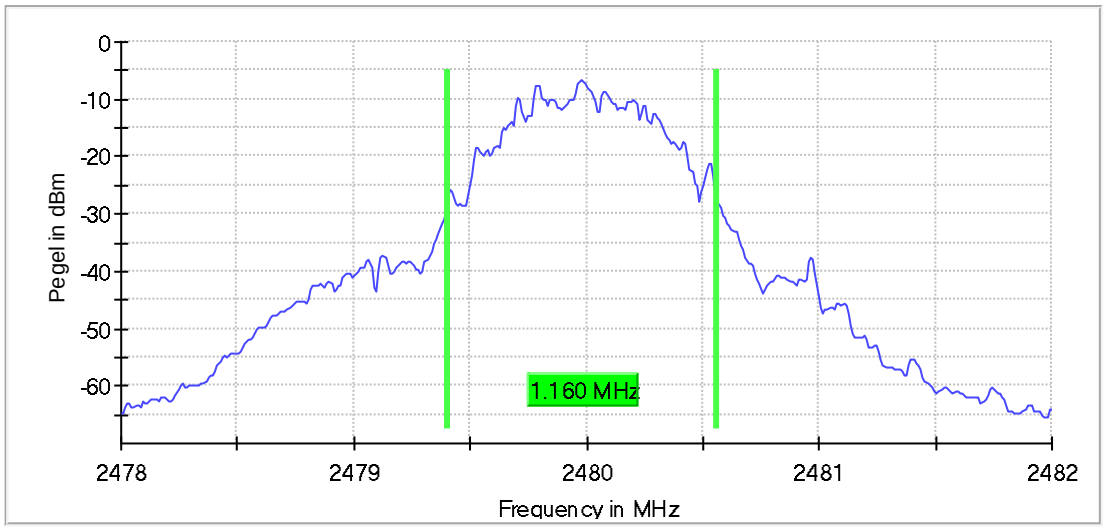
99 %Bandwidth



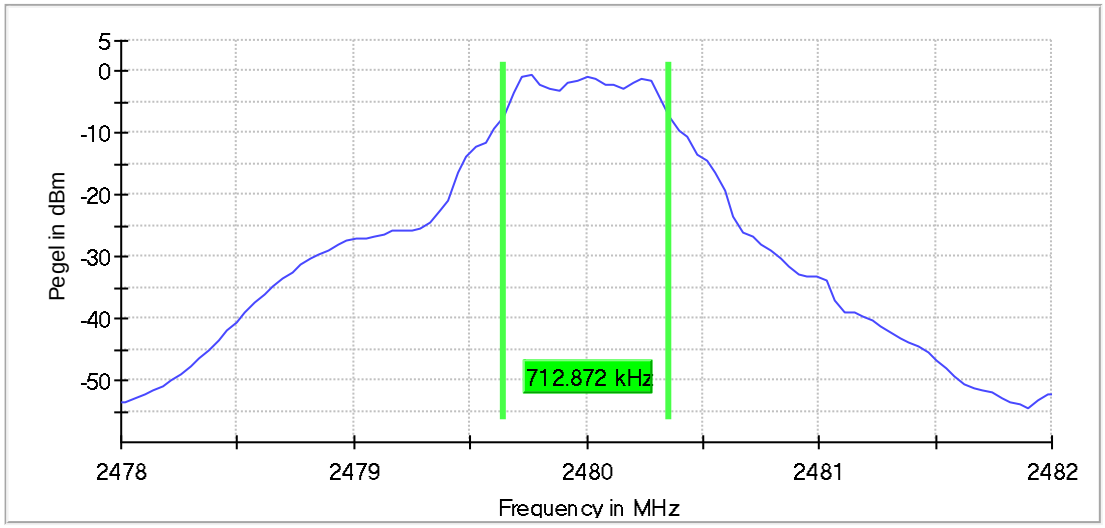
Product Service

Transmission on 2480 MHz

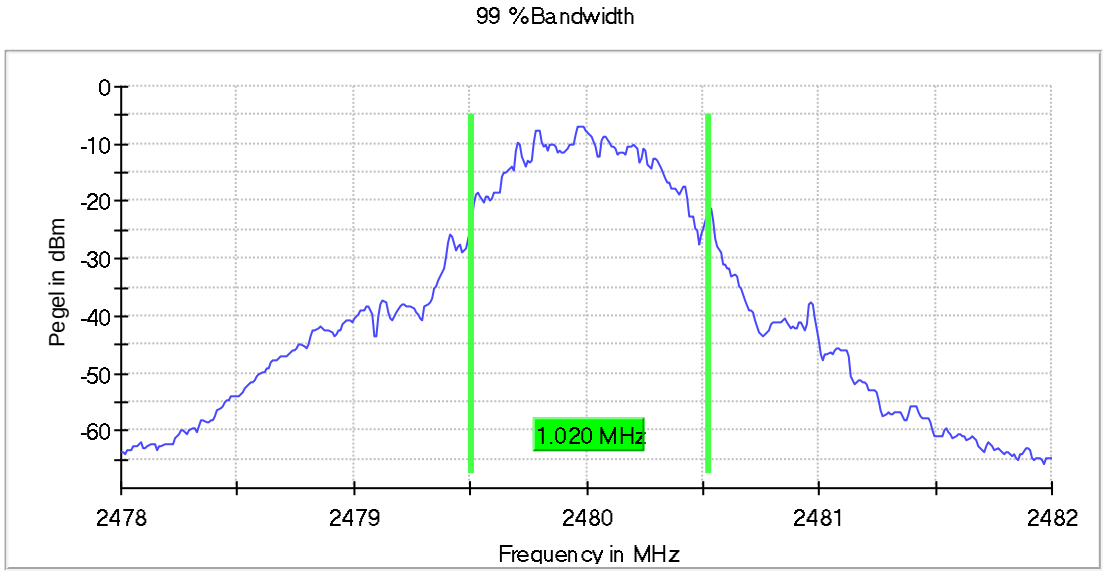
20 dB Bandwidth



6 dB Bandwidth



Product Service



FCC 47 CFR Part 15. Limit Clause 15.247(a)(2) and ISED Canada RSS-210. Clause 5.2(a)

The minimum 6 dB Bandwidth shall be at least 500 kHz.

Product Service

3.4.7 Test Location and Test Equipment Used

Conducted test was carried out in Non-shielded room with Test system TS8997.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Spectrum Analyzer	Rohde & Schwarz	FSV40	20219	12	2024-02-29
Vector Signal Generator	Rohde & Schwarz	SMBV100A	20238	36	2022-11-30
Signal Generator	Rohde & Schwarz	SMB100A	20215	36	2023-12-31
Switching Device	Rohde & Schwarz	OSP120 I	20248	24	2023-02-28
Switching Device	Rohde & Schwarz	OSP120 II	38807	36	2023-11-30
EMC Measurement Software	Rohde & Schwarz	EMC32 TS8997 - V10.50.00	44381	---	---

Table 11

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

Product Service

3.5 Power Spectral Density

3.5.1 Specification Reference

FCC 47 CFR Part 15C. ISED Canada RSS-210 and ISED Canada RSS-GEN

3.5.2 Equipment Under Test and Modification State

BLE (conducted sample). S/N: --- - Modification State 0

3.5.3 Date of Test

2022-09-08

3.5.4 Test Method

This test was performed in accordance with ANSI C63.10. clause 11.10.2.

3.5.5 Environmental Conditions

Ambient Temperature	22.0 °C
Relative Humidity	35.0 %

3.5.6 Test Results

Frequency (MHz)	PSD (dBm)	Limit (dBm)
2402	-11.177	8.0
2440	-11.123	8.0
2480	-10.979	8.0

FCC 47 CFR Part 15. Limit Clause 15.247 (e)

The power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

3.5.7 Test Location and Test Equipment Used

Conducted test was carried out in Non-shielded room with Test system TS8997.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Spectrum Analyzer	Rohde & Schwarz	FSV40	20219	12	2024-02-29
Vector Signal Generator	Rohde & Schwarz	SMBV100A	20238	36	2022-11-30
Signal Generator	Rohde & Schwarz	SMB100A	20215	36	2023-12-31
Switching Device	Rohde & Schwarz	OSP120 I	20248	24	2023-02-28
Switching Device	Rohde & Schwarz	OSP120 II	38807	36	2023-11-30
EMC Measurement Software	Rohde & Schwarz	EMC32 TS8997 - V10.50.00	44381	---	---

Table 12

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

Product Service

3.6 Maximum Conducted Output Power

3.6.1 Specification Reference

FCC 47 CFR Part 15C. ISED Canada RSS-210 and ISED Canada RSS-GEN

3.6.2 Equipment Under Test and Modification State

BLE (conducted sample). S/N: --- - Modification State 0

3.6.3 Date of Test

2022-09-08

3.6.4 Test Method

This test was performed in accordance with ANSI C63.10. clause 11.9.1.1.

3.6.5 Environmental Conditions

Ambient Temperature	22.0 °C
Relative Humidity	35.0 %

Product Service

3.6.6 Test Results

Frequency (MHz)	Peak Power (dBm)	Limit Max (dBm)
2402	2.0	30
2440	2.1	30
2480	2.3	30

FCC 47 CFR Part 15. Limit Clause 15.247 (b)(3)

For systems using digital modulation in the 902–928 MHz. 2400–2483.5 MHz. and 5725–5850 MHz bands: 1 Watt.

3.6.7 Test Location and Test Equipment Used

Conducted test was carried out in Non-shielded room with Test system TS8997.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Spectrum Analyzer	Rohde & Schwarz	FSV40	20219	12	2024-02-29
Vector Signal Generator	Rohde & Schwarz	SMBV100A	20238	36	2022-11-30
Signal Generator	Rohde & Schwarz	SMB100A	20215	36	2023-12-31
Switching Device	Rohde & Schwarz	OSP120 I	20248	24	2023-02-28
Switching Device	Rohde & Schwarz	OSP120 II	38807	36	2023-11-30
EMC Measurement Software	Rohde & Schwarz	EMC32 TS8997 - V10.50.00	44381	---	---

Table 13

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

Product Service

3.7 Transmitter frequency stability

3.7.1 Specification Reference

RSS-Gen

3.7.2 Equipment Under Test and Modification State

BLE (conducted sample). S/N: --- - Modification State 0

3.7.3 Date of Test

2022-09-08

3.7.4 Test Method

RSS-Gen. Issue 5. March 2019. chapter 6.11

3.7.5 Environmental Conditions

Ambient Temperature	22.0 °C
Relative Humidity	35.0 %

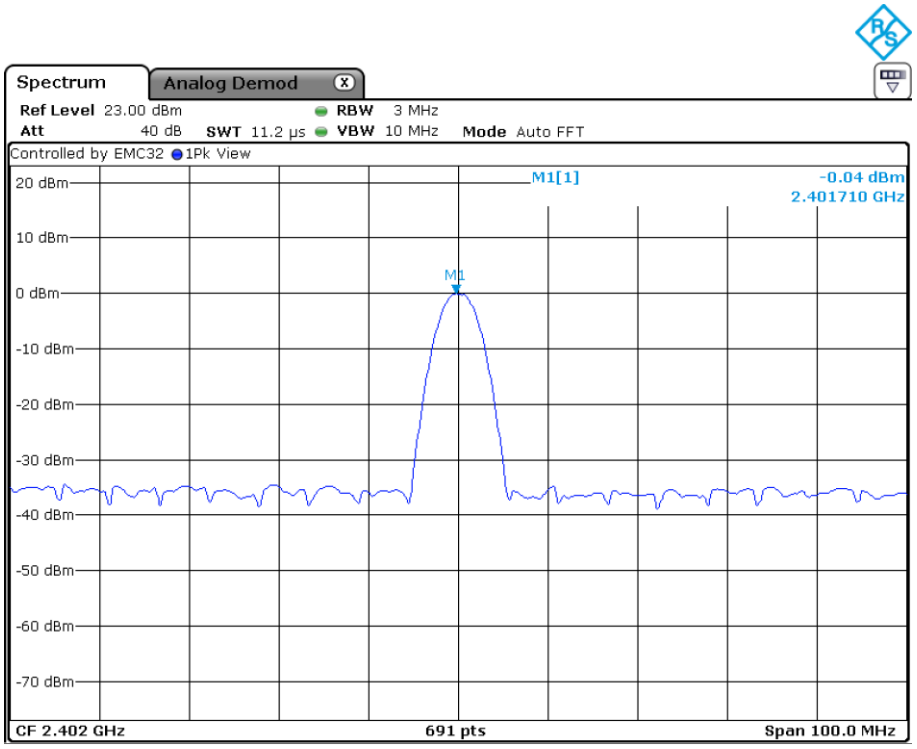
3.7.6 Test Results

Note:

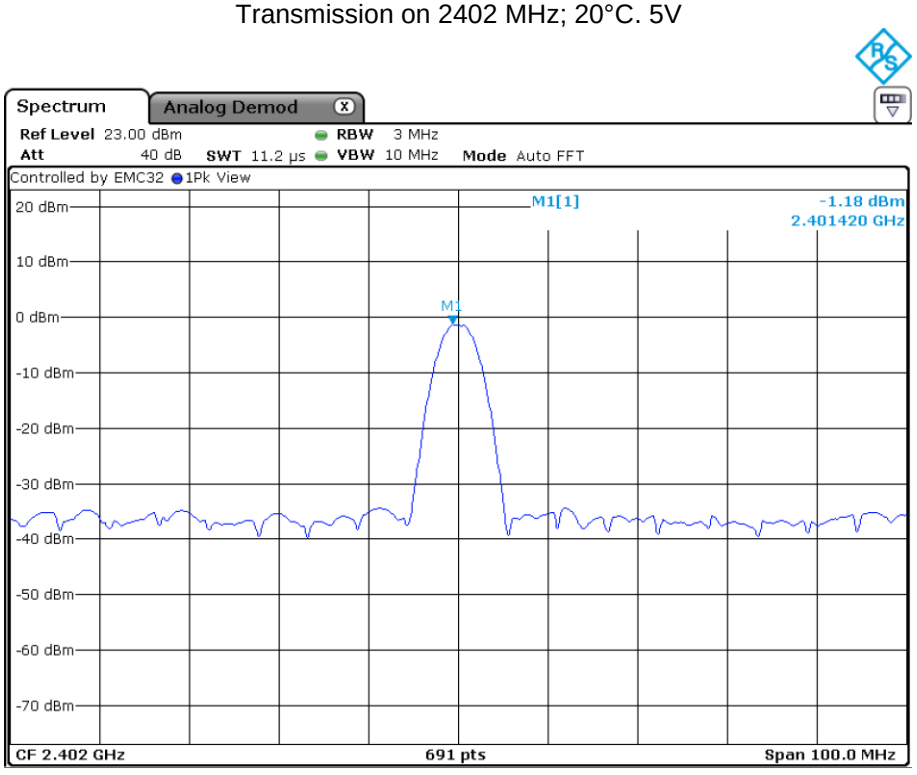
- The requirements for frequency stability under extreme conditions and voltage variations are fulfilled
- The measured frequency error does not affect any band edge requirements

Sample screenshots:

Product Service

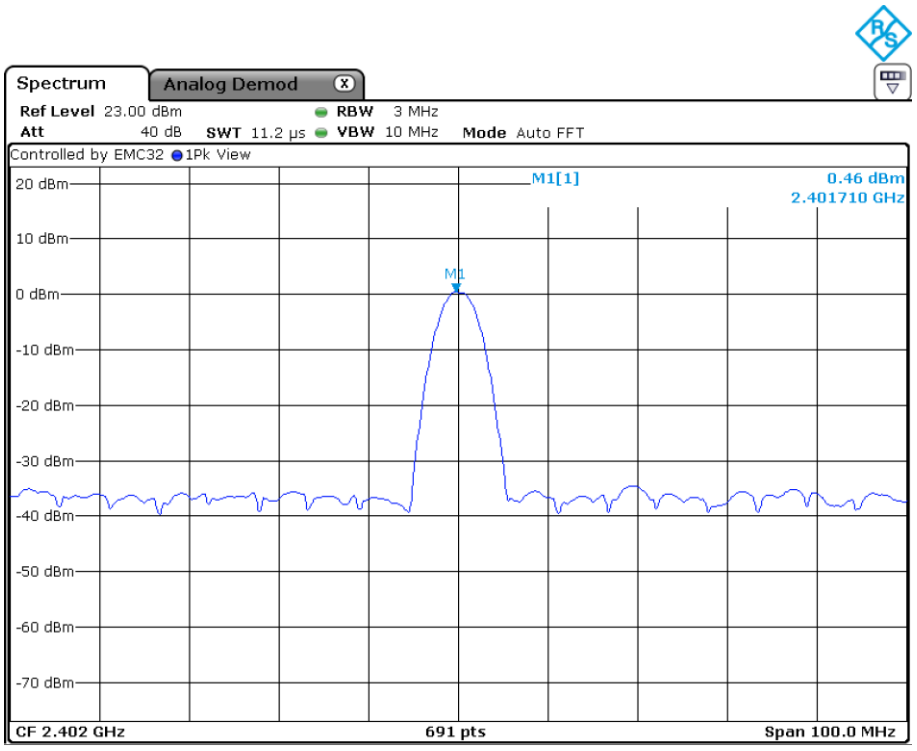


Transmission on 2402 MHz; 20°C. 5V

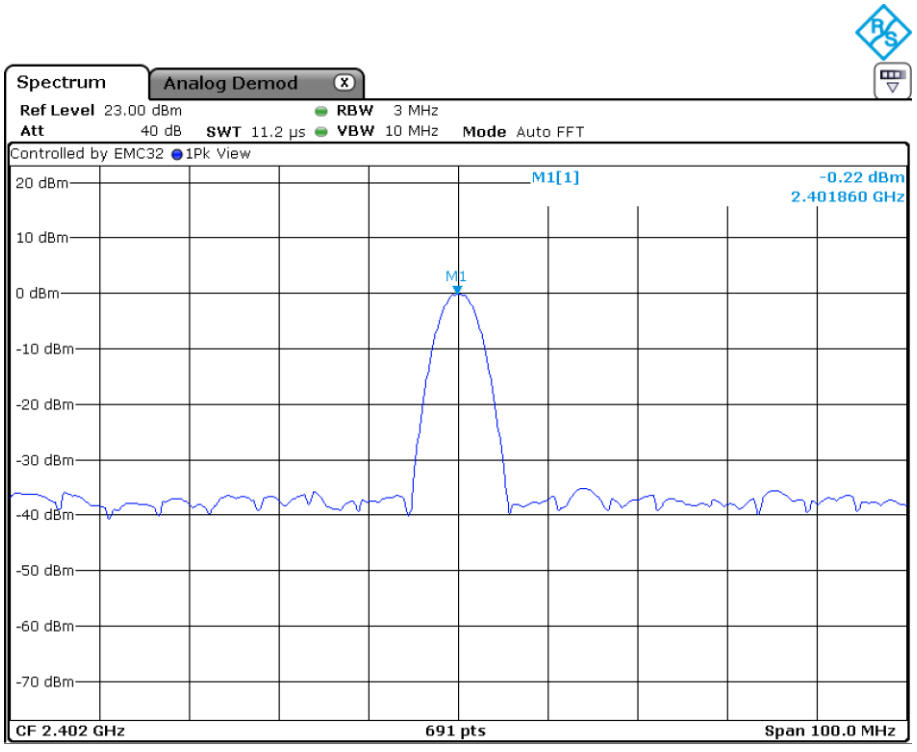


Transmission on 2402 MHz; + 85°C. 5V

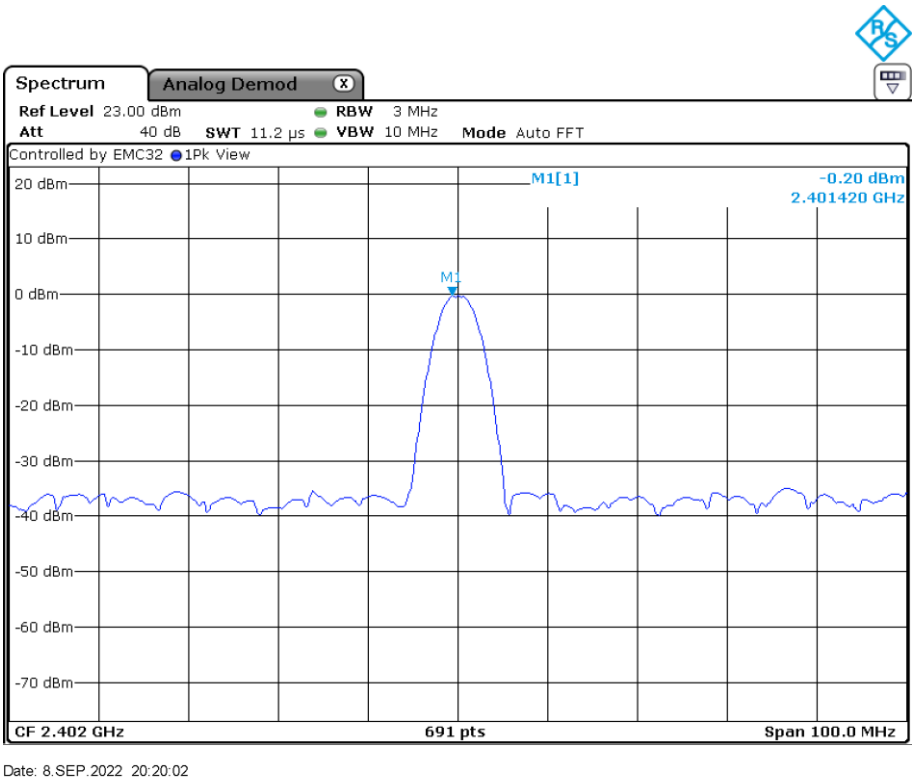
Product Service



Transmission on 2402 MHz; - 30°C. 5V



Transmission on 2402 MHz; 20°C. 4.25V



Transmission on 2402 MHz; 20°C. 5.75V

3.7.7 Test Location and Test Equipment Used

This test was carried out in Non-shielded room.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Spectrum Analyzer	Rohde & Schwarz	FSV40	20219	12	2022-01-31
Climatic test chamber	Feutron	KPK200-2	19868	36	2023-02-28

Table 14

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

Product Service

4 Measurement Uncertainty

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

The measurement uncertainty in the laboratory is less than or equal to the maximum measurement uncertainty according to CISPR16-4-2: 2011 + A1 + A2 + Cor1 (U_{CISPR}). This normative regulation means that the measured value is also the value to be assessed in relation to the limit value.

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 15

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 16

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		a	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 17

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%