

# Report on the FCC and IC Testing of the Endress+Hauser SE+Co.KG K-Band Level Probing Radar. Model: FMR50L / FMR51L / FMR52L

In accordance with CFR 47, Part 15, Subpart C and ISED RSS-GEN Issue 5, RSS-211 Issue 1

Prepared for: Endress+Hauser SE+Co.KG  
Hauptstraße 1D  
79689 Maulburg  
Germany

FCC ID: LCGFMR5XKL  
IC: 2519A-5KL



Product Service

Choose certainty.  
Add value.

## COMMERCIAL-IN-CONFIDENCE

Date: 2020-02-28

Document Number: TR-20351-65854-01 | Issue: 08

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Project Management	Matthias Stumpe	2020-02-28	 SIGN-ID 333569
Authorised Signatory	Markus Biberger	2020-02-28	 SIGN-ID 333581

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 CFR 47, Part 15, Subpart C and ISED RSS-Gen Issue 5 March 2019 Amendment 1, RSS-211 Issue 1 March 2015. The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Matthias Stumpe	2020-02-28	 SIGN-ID 333570

Laboratory Accreditation

DAkKS Reg. No. D-PL-11321-11-02

Laboratory recognition

Registration No. BNetzA-CAB-16/21-15

Industry Canada test site registration

3050A-2

### EXECUTIVE SUMMARY

A sample of this product was tested and found to be compliant with CFR 47, Part 15, Subpart C and ISED RSS-Gen Issue 5 March 2019 Amendment 1, RSS-211 Issue 1 March 2015.

Trade Register Munich  
HRB 85742  
VAT ID No. DE129484267  
Information pursuant to Section 2(1)  
DL-InfoV (Germany) at  
[www.tuev-sued.de](http://www.tuev-sued.de)

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

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

TÜV SÜD Product Service GmbH  
Äußere Frühlingstraße 45  
94315 Straubing  
Germany



## Contents

<b>1</b>	<b>Report Summary .....</b>	<b>2</b>
1.1	Report Modification Record.....	2
1.2	Introduction.....	3
1.3	Brief Summary of Results .....	4
1.4	Product Information .....	5
1.5	Deviations from the Standard.....	10
1.6	EUT Modification Record .....	10
1.7	Test Location .....	11
<b>2</b>	<b>Test Setups .....</b>	<b>12</b>
<b>3</b>	<b>Test Details .....</b>	<b>16</b>
3.1	AC Power Line Conducted Emissions .....	16
3.2	Fundamental Emission Bandwidth.....	19
3.3	Fundamental Emission for Pulsed Transmitters .....	24
3.4	Frequency stability .....	33
3.5	Unwanted emissions .....	40
3.6	Restricted bands of operation .....	70
3.7	Antenna beamwidth.....	82
3.8	Antenna Side Lobe Gain .....	83
3.9	Exposure of Humans to RF Fields .....	91
<b>4</b>	<b>Measurement Uncertainty .....</b>	<b>92</b>

Annex: 10 pages



# 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	2019-08-14
2	Test Results for radar type FMR50T and FMR51T removed from report	2019-09-25
3	Chapter 2.3 – test results verified and corrected	2019-11-29
4	Updated RSS-211 to Issue 1 TLPR removed from Equipment Test Configuration Chapter 2.9 – Test results corrected	2019-12-06
5	Test results for radar model P2, P4 and P5 removed from report Chapter “Test Setups” added to test report	2019-12-16
6	Transmitter Duty Cycle Calculation added to chapter 3.9	2020-01-17
7	Chapter “Exposure of Humans to RF Fields” revised”.	2020-02-05
8	Chapter “3.3 Fundamental Emission for Pulsed Transmitters” updated <ul style="list-style-type: none"> <li>• Resulting overall correction factor calculation revised</li> <li>• Level calculation for Peak, RMS and Average Power revised</li> <li>• Plots for 28MHz RBW measurements in Zero Spam Mode added.</li> </ul> Chapter “3.9 Exposure of Humans to RF Fields” updated to revised Peak emission levels in chapter 3.3	2020-02-28

**Table 1**



Product Service

## 1.2 Introduction

Applicant	Endress+Hauser SE+Co.KG
Manufacturer	Endress+Hauser SE+Co.KG
Model Number(s)	FMR50L, FMR51L, FMR52L
Serial Number(s)	N/A
Hardware Version(s)	N/A
Software Version(s)	N/A
Number of Samples Tested	3
Test Specification/Issue/Date	CFR 47, Part 15, Subpart C ISED RSS-Gen Issue 5 March 2019 Amendment 1 RSS-211 Issue 1 March 2015
Test Plan/Issue/Date	---
Order Number	120/1017713879
Date	2019-07-16
Date of Receipt of EUT	2018-07-30
Start of Test	2018-07-30
Finish of Test	2018-08-05
Name of Engineer(s)	Matthias Stumpe, Agnieszka Hruszcz
Related Document(s)	ANSI C63.10 (2013) KDB 890966 D01 Meas level Probing Radars v01r01

### 1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with CFR 47, Part 15, Subpart C / ISED RSS-GEN Issue 5 / RSS-211 Issue 1 is shown below.

Section	Specification Clause	Test Description	Result	Comments/Base Standard
Configuration and Mode: Normal operation mode: Measurement with pulsed signal				
2.1	15.207 / 8.8 / NA	Conducted limits	Pass	ANSI C63.10 (2013)
2.2	15.256 / NA / 5.1	Fundamental Emission Bandwidth	Pass	ANSI C63.10 (2013)
2.3	15.256 / NA / 5.2	Fundamental Emission for Pulsed Transmitters	Pass	ANSI C63.10 (2013)
2.4	15.215 / 8.11 / NA	Frequency stability	Pass	ANSI C63.10 (2013)
2.5	15.209 / 8.9 / NA	Unwanted emissions	Pass	ANSI C63.10 (2013)
2.6	15.205 / 8.10 / NA	Restricted bands of operation	Pass	ANSI C63.10 (2013)
2.7	15.256 / NA / 5.2	Antenna beamwidth	Pass	ANSI C63.10 (2013)
2.8	15.256 / NA / 5.2	Antenna Side Lobe Gain	Pass	ANSI C63.10 (2013)
2.9	FCC 47 CFR Part 1.1310 RSS-102 Issue 5	Exposure of Humans to RF Fields	Pass	NA

**Table 2**



**1.4 Product Information**

**1.4.1 Technical Description**

<b>Equipment characteristics</b>	
Type designation:	FMR50L / FMR51L / FMR52LL
Parts of the system:	---
Options and accessories:	---
Type of equipment:	K-Band Level Probing Radar
Serial number:	NA
Manufacturer:	Endress+Hauser SE+Co.KG
Application frequency range:	24.05 GHz - 29.0 GHz
Operating frequency:	25.2 GHz
Type of modulation:	1G50P0NAN
Pulse train / width:	558.54 ns / 2.04 ns
Channel spacing:	N/A
Designation of emissions	1G50P0NAN
Power supply:	External DC supply Nominal: 24.0 V DC (10.2 to 34.6 V DC) Nominal frequency: 0 Hz (DC)
Highest internal frequency:	240 MHz, 76 GHz for Radar
Version of EUT:	N/A

<b>Technical Description</b>
The Equipment Under Test (EUT) is a level probing radar with different operational modes and configurations. EUT is operating in K-Band (24.05 GHz - 29.0 GHz ) with a pulsed signal. Radar is using HART protocol on DC supply interface (Highway Addressable Remote Transducer).

<b>Operation Mode(s)</b>
Normal operation mode: Measurement with pulsed signal



Product Service

<b>Equipment Test Configurations</b>			
<b>Configuration</b>	<b>Basis</b>	<b>Antenna</b>	<b>Mode</b>
P2LPR	FMR50L	Horn 100mm/4" PP cladded	LPR
P4LPR	FMR51L	Horn 100mm/4"	LPR
P5LPR	FMR52L	Horn 80mm/3" flush mount	LPR

LPR: Level Probing Radar – Operation outside enclosure (storage tank) with intentional emission to open-air environments



**Marking Plate**

Made in Germany, 79689 Maulburg, Hauptstr. 1		<b>Endress+Hauser</b>	
<b>Micropilot</b>		IP68 / 66 Type 4X / 6P Encl.	
Order code: FMR50-1WQ6/0			
Ser. no.: 12345678901234			
Ext. ord. cd.: FMR50-AAACCABRX0G+			
10.4...35 V DC / 2-wire 4...20 mA HART			
Tp max: 80°C MWP: 3 bar / 43psi			
M20x1.5 / M16x1.5			
Ta: -40...+80 °C Ta > 60 °C: $t_{Ta} + 20 K$		FCC ID LCGFMR5XKL	
Mat.: FKM, PP			
FW: 01.02.02 Dev.Rev.:3 ex works		→	
0700		X = if modification see sep. label Patents →	
		Date: 2019-09	

Made in Germany, 79689 Maulburg, Hauptstr. 1		<b>Endress+Hauser</b>	
<b>Micropilot</b>		IP68 / 66 Type 4X / 6P Encl.	
Order code: FMR50-1WQ6/0		CRN OF 15872.5C	
Ser. no.: 12345678901234			
Ext. ord. cd.: FMR50-AAACCABRX0G+			
10.4...35 V DC / 2-wire 4...20 mA HART			
Tp max: 80°C MWP: 3 bar / 43psi			
M20x1.5 / M16x1.5			
Ta: -40...+80 °C Ta > 60 °C: $t_{Ta} + 20 K$		MODEL FMR50L IC:2519A-5KL	
Mat.: FKM, PP			
FW: 01.02.02 Dev.Rev.:3 ex works		→	
0700		X = if modification see sep. label Patents →	
		Date: 2019-09	





**Marking Plate**

Made in Germany, 79689 Maulburg, Hauptstr. 1		<b>Endress+Hauser</b>	
<b>Micropilot</b>		IP68 / 66 Type 4X / 6P Encl.	
Order code: FMR51-5CC4/0			
Ser. no.: 12345678901234			
Ext. ord. cd.: FMR51-AAACCBDA5CJJ+			
10.4...35 V DC / 2-wire 4...20 mA HART			
Tp max: 150°C MWP: 16 bar			
M20x1.5 / M16x1.5			
Ta: -40...+80 °C Ta > 60 °C: $t_{zTa} + 20 K$		FCC ID LCGFMR5XKL	
Mat.: FKM, PTFE, 316L			
FW: 01.02.02 Dev.Rev.:3 ex works		→	
0700			
		X = if modification see sep. label Patents →	
		Date: 2019-09	

Made in Germany, 79689 Maulburg, Hauptstr. 1		<b>Endress+Hauser</b>	
<b>Micropilot</b>		IP68 / 66 Type 4X / 6P Encl.	
Order code: FMR51-5CC4/0			
Ser. no.: 12345678901234			
Ext. ord. cd.: FMR51-AAACCBDA5CJJ+			
10.4...35 V DC / 2-wire 4...20 mA HART			
Tp max: 150°C MWP: 16 bar			
M20x1.5 / M16x1.5			
Ta: -40...+80 °C Ta > 60 °C: $t_{zTa} + 20 K$		MODEL FMR51L IC:2519A-5KL	
Mat.: FKM, PTFE, 316L			
FW: 01.02.02 Dev.Rev.:3 ex works		→	
0700			
		X = if modification see sep. label Patents →	
		Date: 2019-09	



**Marking Plate**

Made in Germany, 79689 Maulburg, Hauptstr. 1 <b>Micropilot</b>		<b>Endress+Hauser</b>	
Order code: FMR52-1VN6/0 Ser. no.: 12345678901234 Ext. ord. cd.: FMR52-AAACCABPCJK+		IP68 / 66 Type 4X / 6P Encl.	
10.4...35 V DC / 2-wire 4...20 mA HART			
T <sub>p</sub> max: 200°C MWP: 16 bar M20x1.5 / M16x1.5		FCC ID LCGFMR5XKL	
T <sub>a</sub> : -40...+80 °C T <sub>a</sub> > 60 °C: (T <sub>a</sub> + 20 K)		Mat.: PTFE	
FW: 01.02.02 Dev.Rev.:3 ex works 0700		Patents →	
		X = if modification see sep. label Date: 2019-09	

Made in Germany, 79689 Maulburg, Hauptstr. 1 <b>Micropilot</b>		<b>Endress+Hauser</b>	
Order code: FMR52-1VN6/0 Ser. no.: 12345678901234 Ext. ord. cd.: FMR52-AAACCABPCJK+		IP68 / 66 Type 4X / 6P Encl.	
10.4...35 V DC / 2-wire 4...20 mA HART			
T <sub>p</sub> max: 200°C MWP: 16 bar M20x1.5 / M16x1.5		MODEL FMR52L IC:2519A-5KL	
T <sub>a</sub> : -40...+80 °C T <sub>a</sub> > 60 °C: (T <sub>a</sub> + 20 K)		Mat.: PTFE	
FW: 01.02.02 Dev.Rev.:3 ex works 0700		Patents →	
		X = if modification see sep. label Date: 2019-09	



**1.5 Deviations from the Standard**

none

**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
EUT: P2LPR - Serial Number: N/A			
0	As supplied by the customer	Not Applicable	Not Applicable

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
EUT: P4LPR - Serial Number: N/A			
0	As supplied by the customer	Not Applicable	Not Applicable

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
EUT: P5LPR - Serial Number: N/A			
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.

<b>Test Name</b>	<b>Name of Engineer(s)</b>
<b>All configurations - Normal operation mode</b>	
AC Power Line Conducted Emissions	Matthias Stumpe
Fundamental Emission Bandwidth	Matthias Stumpe
Fundamental Emission for Pulsed Transmitters	Matthias Stumpe, Agnieszka Hruszcz
Frequency stability	Matthias Stumpe
Unwanted emissions	Matthias Stumpe
Restricted bands of operation	Matthias Stumpe
Antenna beamwidth	Johann Roidt
Antenna Side Lobe Gain	Johann Roidt
Exposure of Humans to RF Fields	Matthias Stumpe

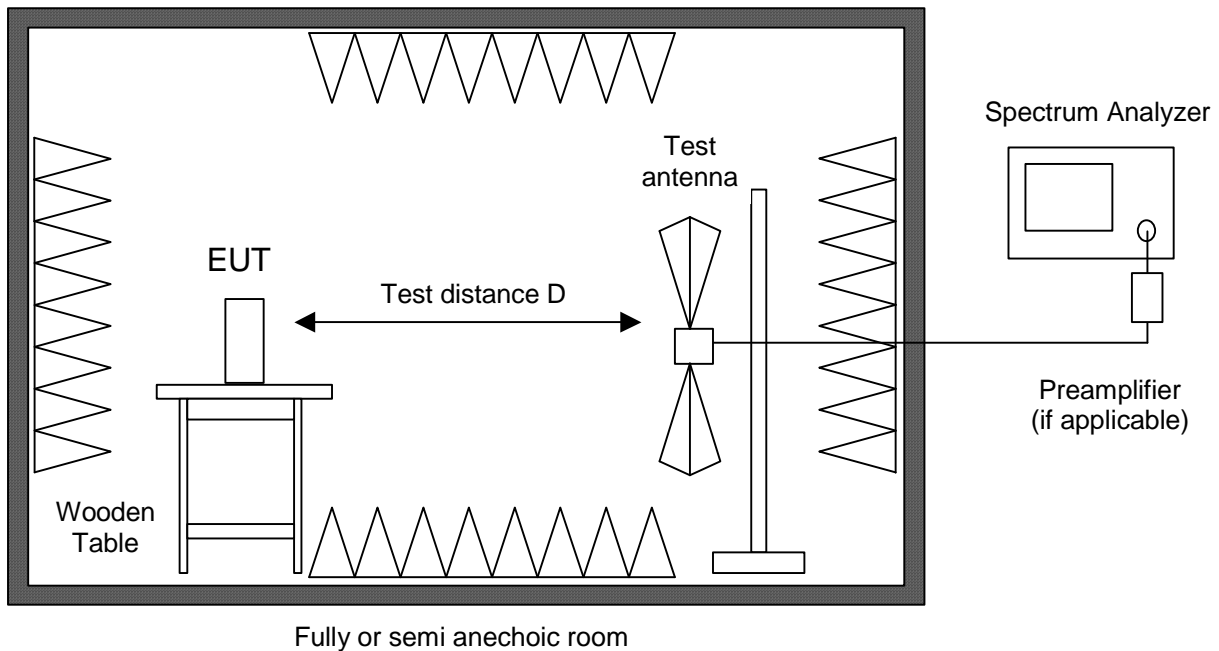
**Table 4**

Office Address:

Äußere Frühlingstraße 45  
94315 Straubing  
Germany

## 2 Test Setups

### 2.1.1.1 Radiated Emission in 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 2.1.1.2). If prescans are recorded in fully anechoic room they are indicated appropriately.



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.

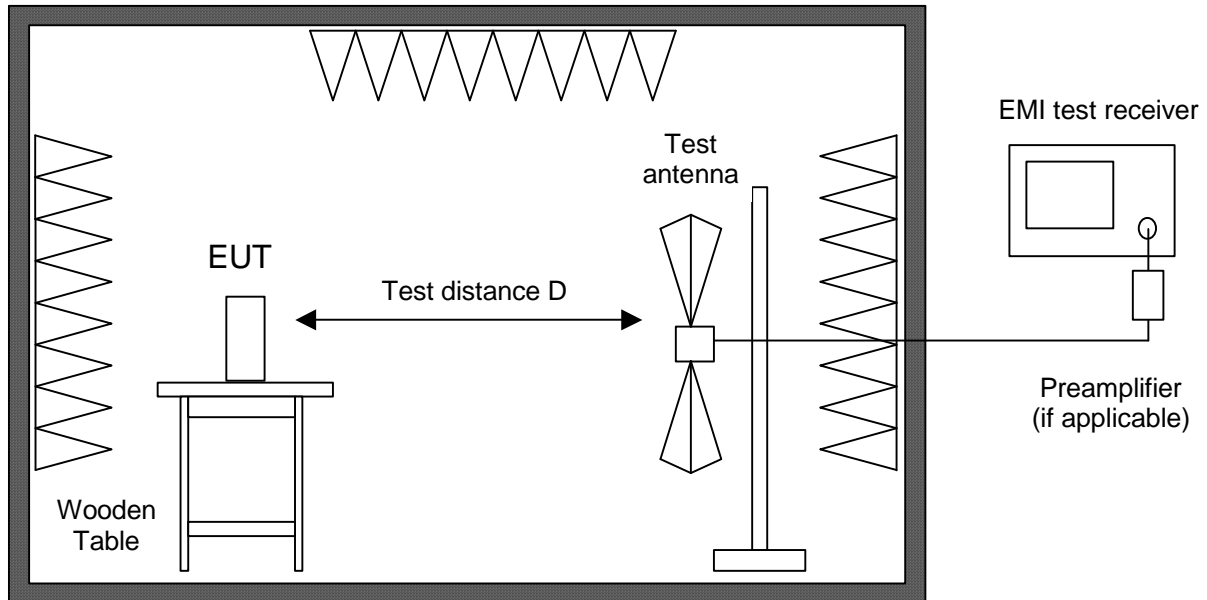
EUT is rotated all around to find the maximum levels of emissions. Equipment and cables are placed and moved within the range of position likely to find their maximum emissions.

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.

### 2.1.1.2 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 discharged 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.



Product Service

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.





### 3 Test Details

#### 3.1 AC Power Line Conducted Emissions

##### 3.1.1 Specification Reference

FCC 47 CFR Part 15C Clause 15.207, Canada RSS-GEN Clause 8.8

##### 3.1.2 Equipment Under Test and Modification State

P2LPR, S/N: N/A - Modification State 0

AC Power Line Conducted Emissions was performed only on one EUT because all EUTs an EUT configurations contain the same electronic and transceiver hardware.

##### 3.1.3 Date of Test

2018-08-05

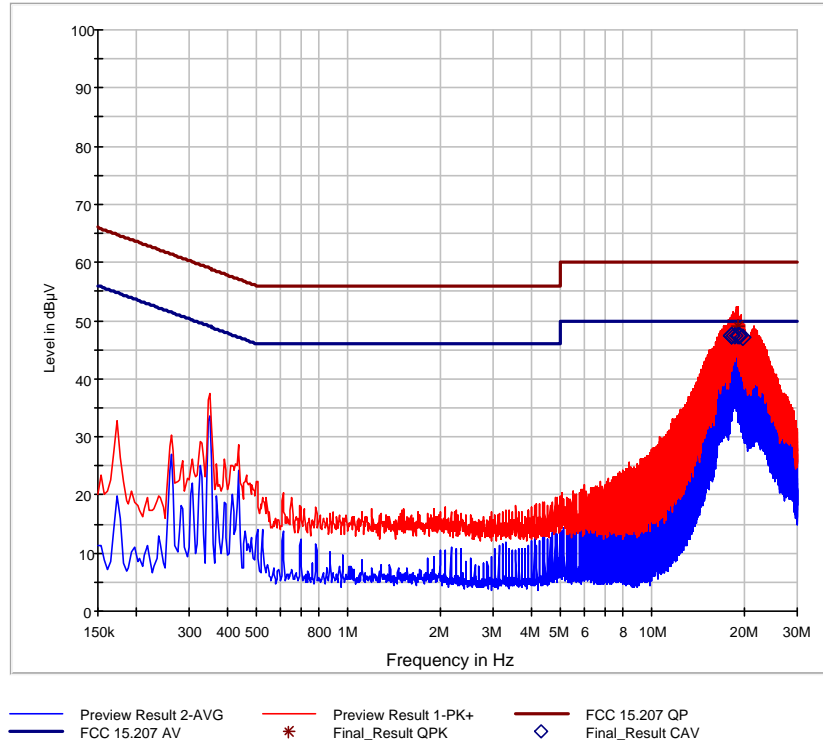
##### 3.1.4 Environmental Conditions

Ambient Temperature	24,0 °C
Relative Humidity	50,0 %



### 3.1.5 Test Results

Normal operation mode: Measurement with pulsed signal



#### Final Results:

Frequency MHz	QuasiPeak dBµV	CAverage dBµV	Limit dBµV	Margin dB	Meas. Time ms	Bandwidth kHz	Line	PE	Corr. dB
18.270000	---	47.28	50.00	2.72	1000.0	9.000	Minus	GND	10.3
18.358000	---	47.37	50.00	2.63	1000.0	9.000	Minus	GND	10.3
18.618000	---	47.38	50.00	2.62	1000.0	9.000	Minus	GND	10.3
19.054000	---	47.31	50.00	2.70	1000.0	9.000	Minus	GND	10.3
19.054000	49.07	---	50.00	10.93	1000.0	9.000	Minus	GND	10.3
19.402000	---	47.28	50.00	2.72	1000.0	9.000	Minus	GND	10.3
19.750000	---	47.01	50.00	2.99	1000.0	9.000	Minus	GND	10.3

#### Plus and Minus Line Emissions Results



FCC 47 CFR Part 15, Limit Clause 15.207 and Industry 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 5**

\*Decreases with the logarithm of the frequency.

**3.1.6 Test Location and Test Equipment Used**

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

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
EMI test receiver	Rohde & Schwarz	ESU8	19904	12	12.2019
V-network	Rohde & Schwarz	ESH 3 Z5	18919	36	10.2019
Shielded room	Albatross	No. 09	---	---	---
EMC Measurement Software	Rohde&Schwarz	EMC32 V10.20.01	19719	N/A	N/A

**Table 8**

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



**3.2 Fundamental Emission Bandwidth**

**3.2.1 Specification Reference**

FCC 47 CFR Part 15C, Clause 15.256(f)  
 Industry Canada RSS-211 and Industry Canada RSS-GEN

**3.2.2 Equipment Under Test and Modification State**

P2LPR, S/N: N/A - Modification State 0  
 P4LPR, S/N: N/A - Modification State 0  
 P5LPR, S/N: N/A - Modification State 0

**3.2.3 Date of Test**

2018-07-30 to 2019-08-06

**3.2.4 Test Method**

The test was performed in accordance with  
 ANSI C63.10  
 KDB 890966 D01  
 RSS-211

**3.2.5 Environmental Conditions**

Ambient Temperature 22,0 °C  
 Relative Humidity 31,0 %

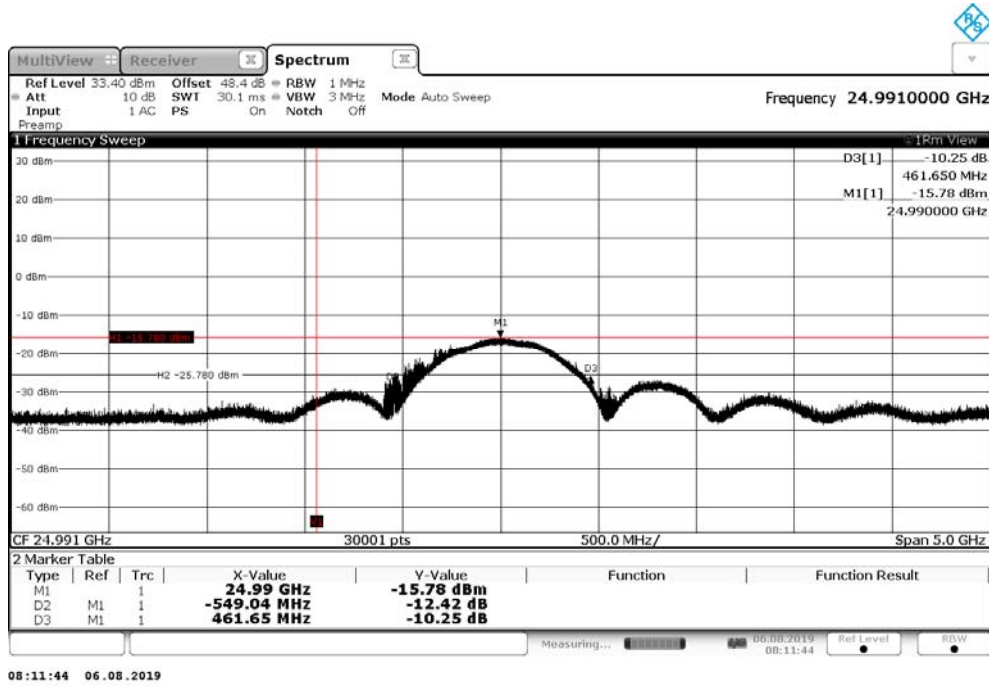
**3.2.6 Test Results**

Normal operation mode: Measurement with pulsed signal

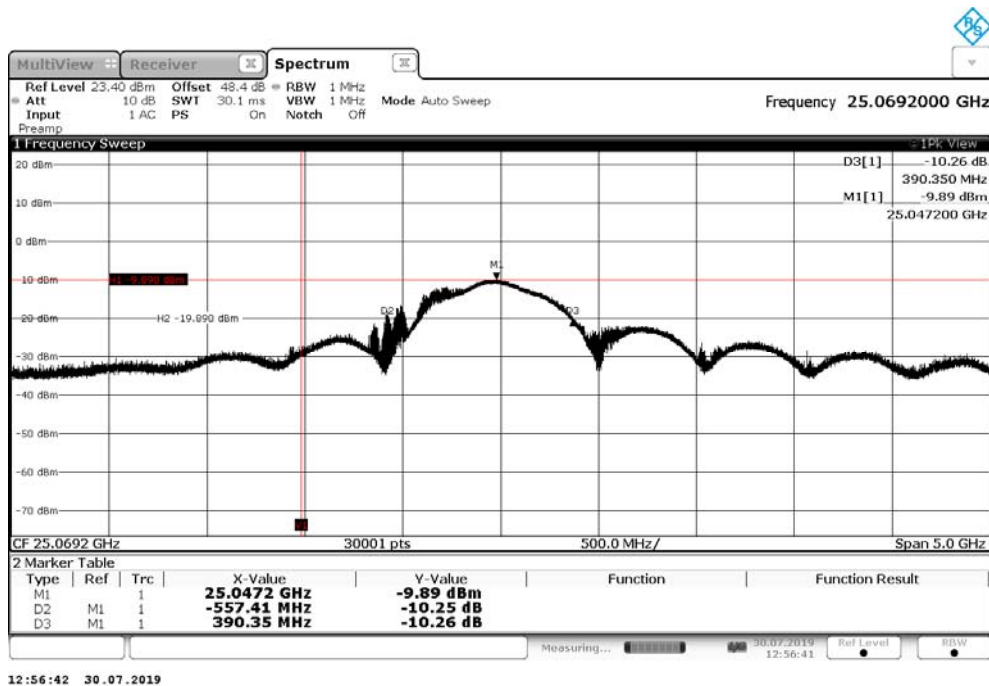
<i>Equipment Under Test</i>	<i>10 dB Bandwidth (MHz)</i>	<i>f-10dB lower (GHz)</i>	<i>f-10 upper (GHz)</i>
P2LPR	1055.69	24.39596	25.45165
P4LPR	947.76	24.48979	25.43755
P5LPR	1225.9	24.52235	25.77825

<i>Equipment Under Test</i>	<i>99% Bandwidth (MHz)</i>	<i>f 99% lower (GHz)</i>	<i>f 99% upper (GHz)</i>
P2LPR	1808	24.108	25.916
P4LPR	1757	24.188	25.945
P5LPR	1698	24.224	25.922

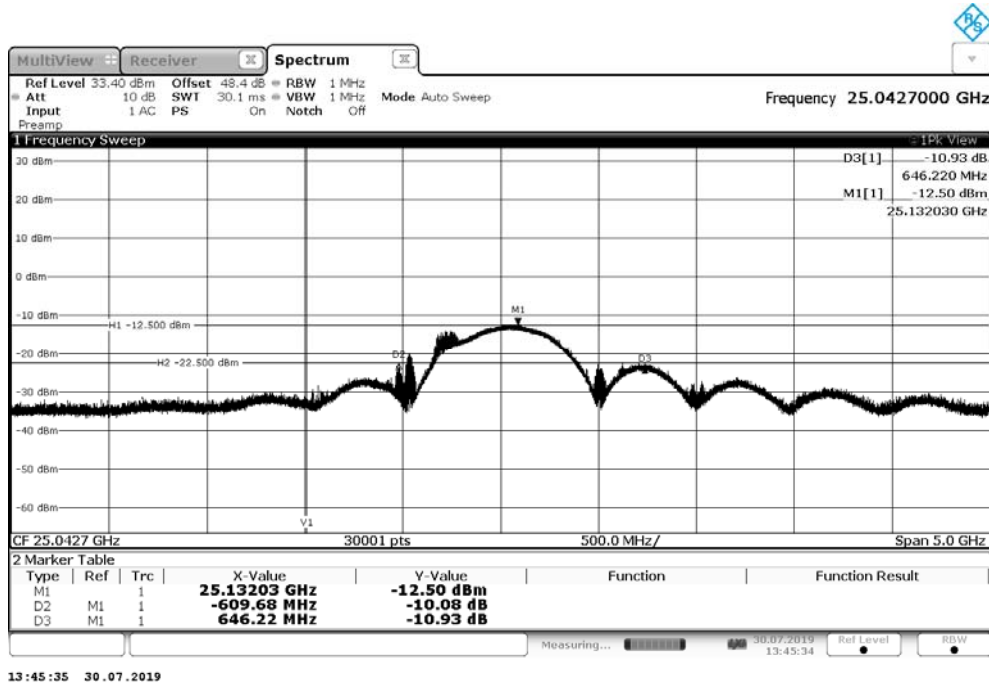
**Table 6**



**Fundamental Emission -10 dB Bandwidth - P2LPR**

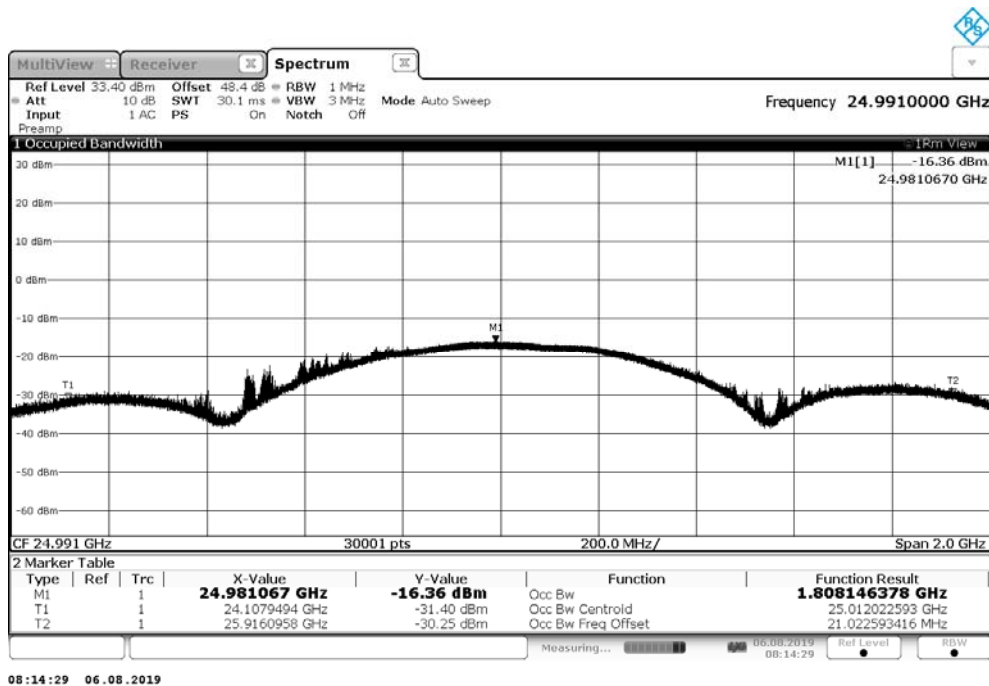


**Fundamental Emission -10 dB Bandwidth – P4LPR**



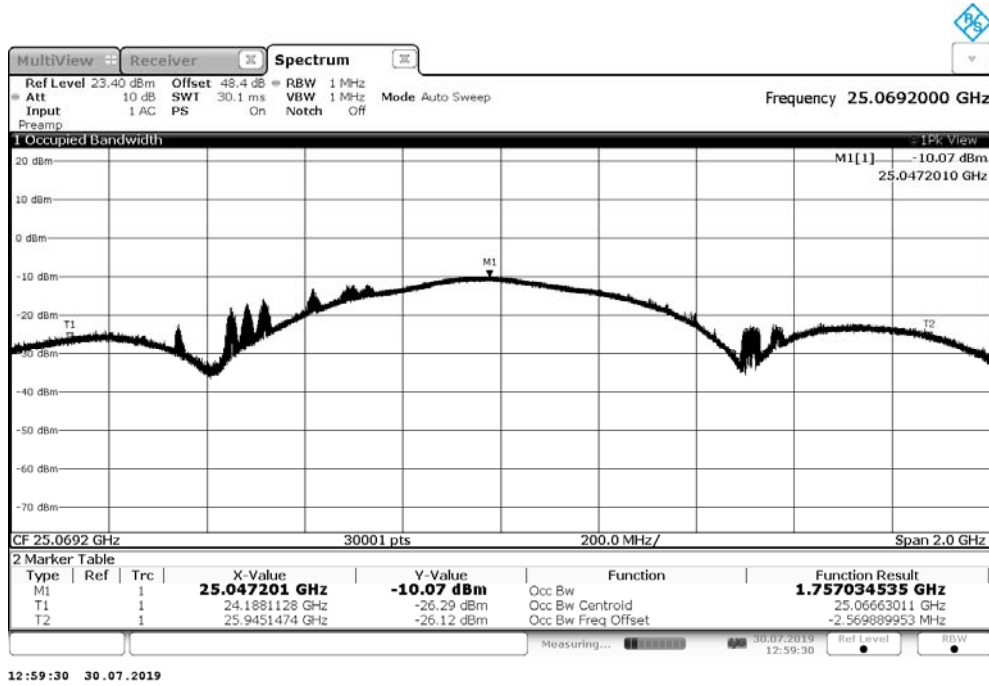
13:45:35 30.07.2019

**Fundamental Emission -10 dB Bandwidth – P5LPR**

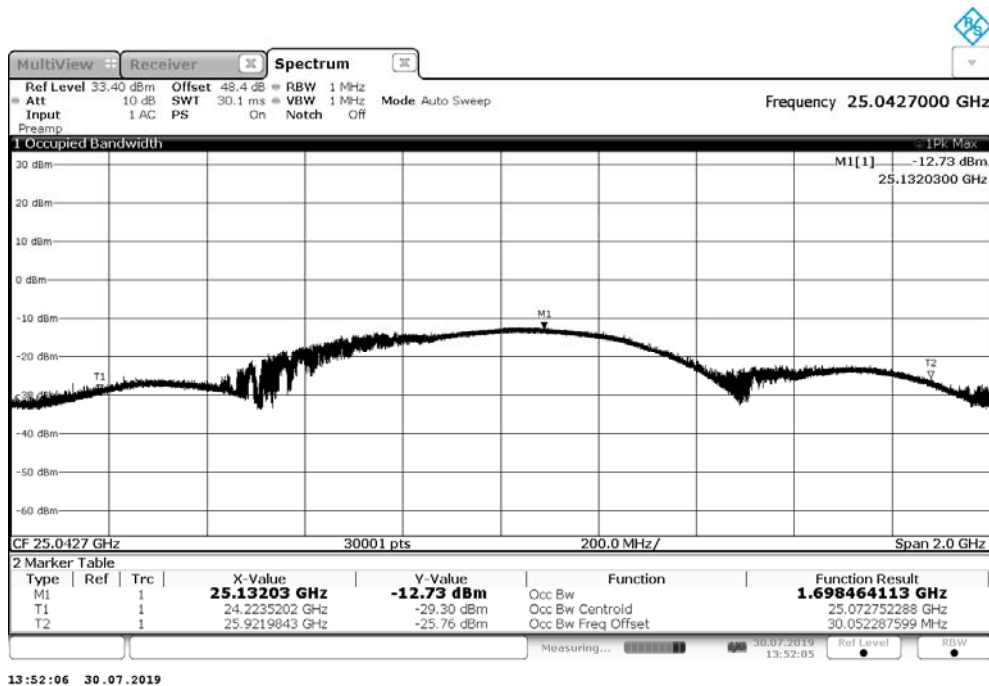


08:14:29 06.08.2019

**Fundamental Emission 99% Bandwidth – P2LPR**



**Fundamental Emission 99% Bandwidth – P4LPR**



**Fundamental Emission 99% Bandwidth – P5LPR**



**FCC 47 CFR Part 15, Limit Clause 15.256 (f)**

The minimum fundamental emission bandwidth shall be 50 MHz for LPR operation.

**Industry Canada RSS 211 and Industry Canada RSS GEN, Limit Clause**

The minimum bandwidth at the -10 dB point is 50 MHz

**3.2.7 Test Location and Test Equipment Used**

This test was carried out in Fully Anechoic Room no. 2.

<i>T-ID</i>	<i>Designation</i>	<i>Type</i>	<i>Last Cal.</i>	<i>Next Cal.</i>
19125	Horn antenna	3160-09	Verified	
19383	Double ridged waveguide horn antenna	3115	2017-02	2020-02
19442	Horn antenna	3160-10	Verified	
19946	Horn antenna	24240-20	Verified	
22553	Waveguide mixer	FS-Z170	2016-08	2019-08
25849	Waveguide mixer	FS-Z60	2017-04	2020-04
25850	Waveguide mixer	FS-Z90	2016-12	2019-12
25851	Waveguide mixer	FS-Z110	2016-11	2019-11
27898	Horn antenna	26240-20	Verified	
27899	Horn antenna	27240-20	Verified	
39897	EMI test receiver	ESW44	2019-02	2020-02
36954	Harmonic Mixer	FS-Z220	2018-03	2021-03
36955	Harmonic Mixer	FS-Z325	2018-02	2021-02
37863	Horn antenna	30240-20 WG30	Verified	
37864	Horn antenna	32240-20 WG32	Verified	
38401	ULTRALOG Antenna	HL562E	2018-05	2021-05

**Table 7**





Product Service

### **3.3 Fundamental Emission for Pulsed Transmitters**

#### **3.3.1 Specification Reference**

FCC 47 CFR Part 15C, Clause 15.256(g)  
Industry Canada RSS-211 and Industry Canada RSS-GEN

#### **3.3.2 Equipment Under Test and Modification State**

P2LPR, S/N: N/A - Modification State 0  
P4LPR, S/N: N/A - Modification State 0  
P5LPR, S/N: N/A - Modification State 0

#### **3.3.3 Date of Test**

2019-11-29

#### **3.3.4 Test Method**

The test was performed in accordance with  
ANSI C63.10  
KDB 890966 D01  
RSS-211

#### **3.3.5 Environmental Conditions**

Ambient Temperature	22.0 °C
Relative Humidity	39.0 %

### 3.3.6 Test Results

P2LPR and P4LPR were measured at the distance of 0.8 meter.  
 P5LPR was measured at the distance of 0.7 meter.

Measuring distance (m)	0.7 (P5LPR)	0.8 (P2LPR, P4LPR)
Cable attenuation (dB) (cable between antenna and spectrum analyser)	2.9	
Antenna Gain (dBi)	16.8	
Free Space Loss (dB)	57.3	58.46
Resulting overall correction factor (dB)	43.40	44.56

**Table 8**

FCC 47 CFR Part 15C, Clause 15.256(g)

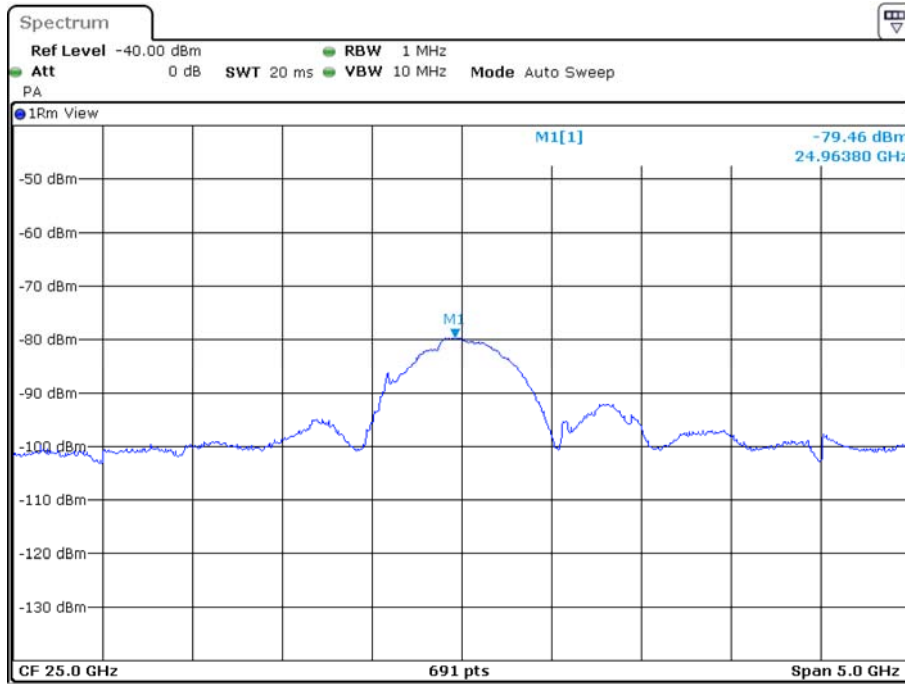
Equipment Under Test	P2LPR	P4LPR	P5LPR
f Max Level (GHz)	24.96380	24.991830	25.07000
RMS at 1 MHz RBW (dBm) – reading Value	-79.46	-67.81	-70.47
RMS Level at 1 MHz RBW (dBm) – final result including correction factor.	-34.9	-23.25	-27.07
RMS emission limit EIRP dBm	-14		
Margin	20.9	9.25	13.07
Verdict	PASS	PASS	PASS

Max Peak Signal Level was measured with 28 MHz RBW.

The bandwidth correction factor was calculated in accordance to the KDB 890966 D01 - E.5.a The bandwidth correction factor is equal to +5.036 dB and was added to the maximum peak value measured at 28 MHz RBW.

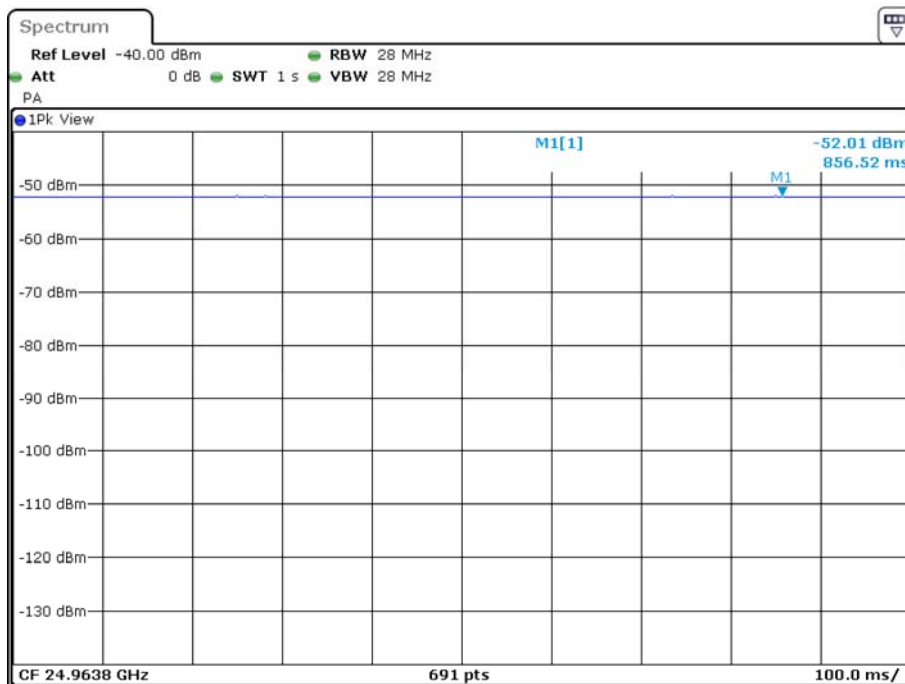
Normal operation mode: Measurement with pulsed signal:

Equipment Under Test	P2LPR	P4LPR	P5LPR
f Max Level (GHz)	24.96	24.99	25.07
Max Peak Level at 28 MHz RBW (dBm) – reading value	-52.01	-42.70	-43.58
Max Peak Level at 50 MHz RBW (dBm) – final result	-2.41	6.90	4.86
Peak emission limit EIRP dBm	26		
Margin	28.41	19.1	23.6
Verdict	PASS	PASS	PASS



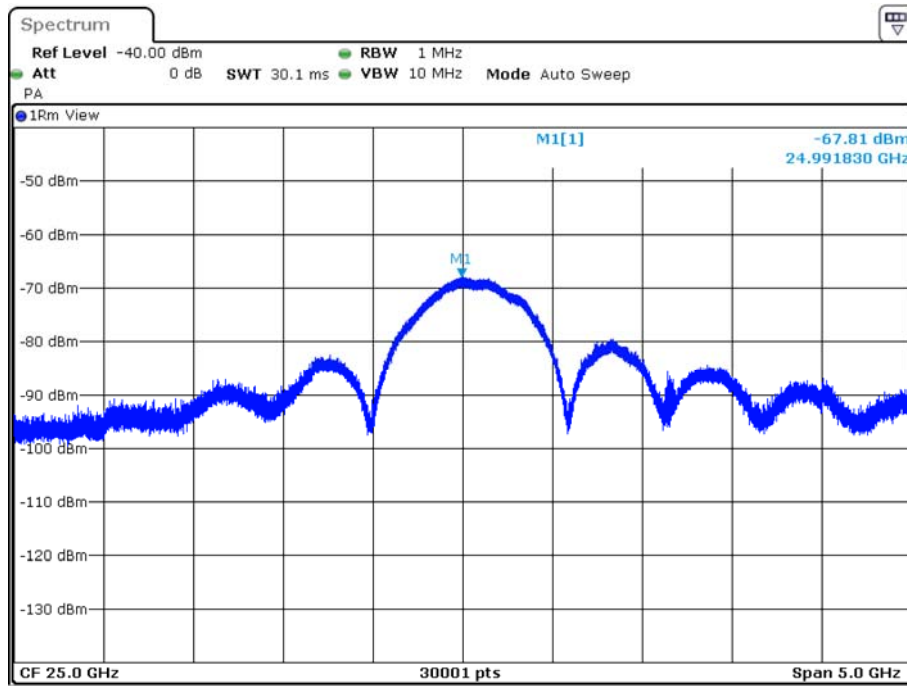
Date: 28.NOV.2019 13:17:04

**Fundamental Emission - 1MHz RBW, RMS - P2LPR**



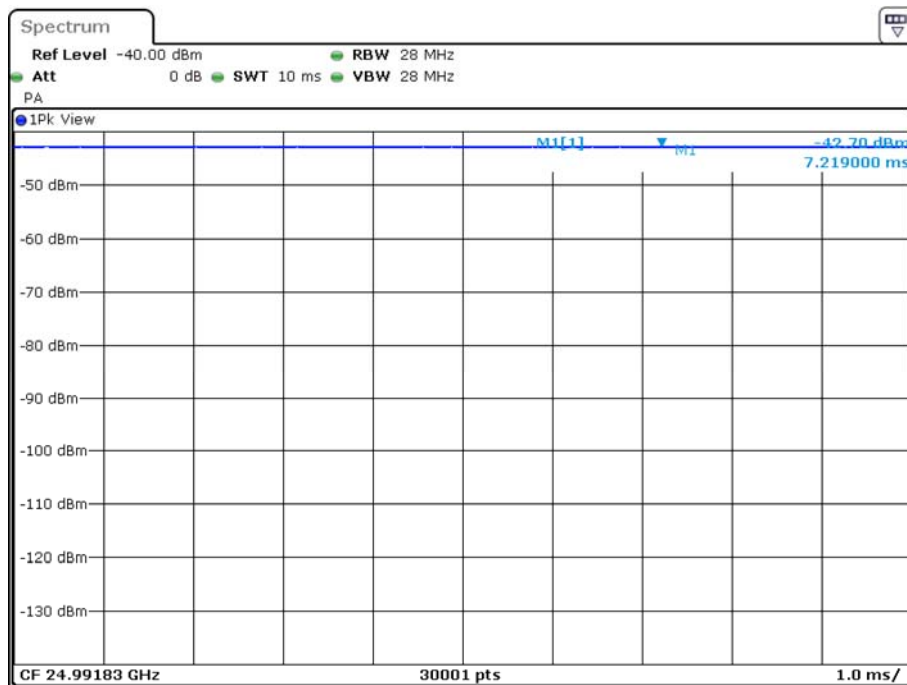
Date: 28.NOV.2019 13:23:11

**Fundamental Emission – 28 MHz RBW, Peak, Zero Span – P2LPR**



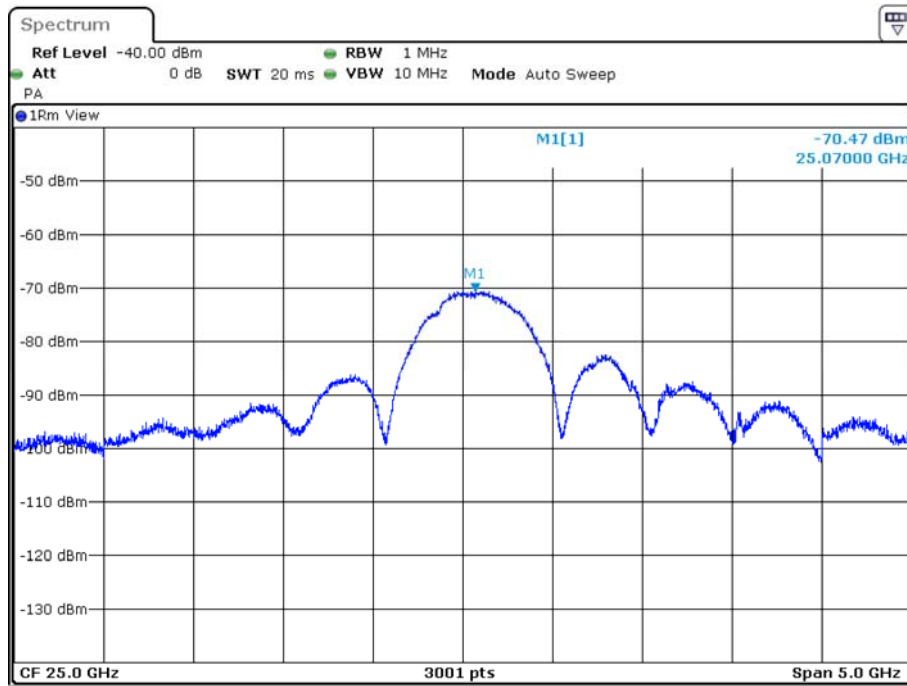
Date: 28.NOV.2019 14:52:39

**Fundamental Emission - 1MHz RBW, RMS – P4LPR**



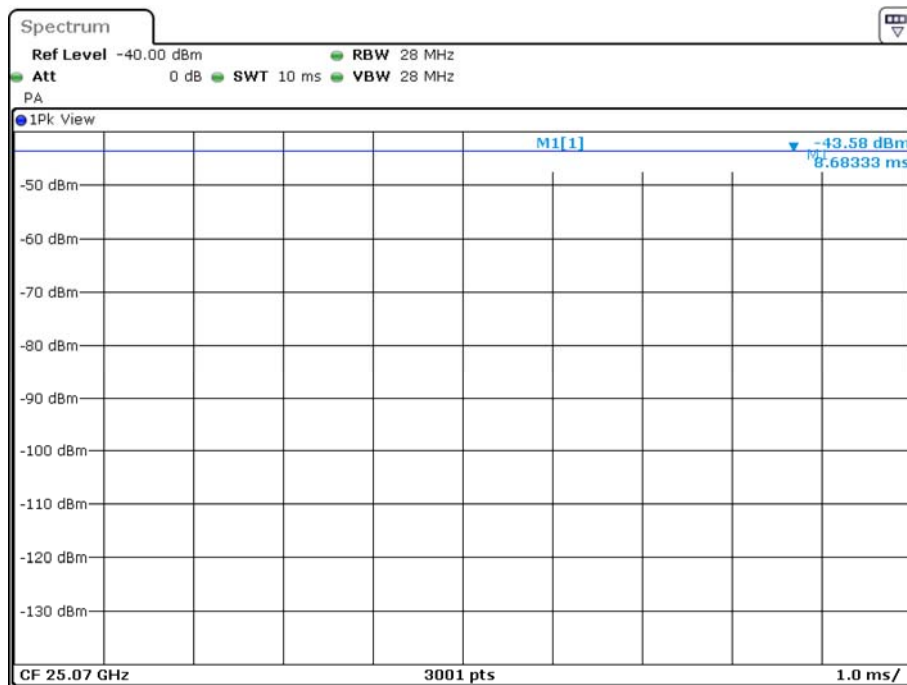
Date: 28.NOV.2019 14:55:14

**Fundamental Emission – 28 MHz RBW, Peak, Zero Span – P4LPR**



Date: 28.NOV.2019 14:17:54

**Fundamental Emission - 1MHz RBW, RMS – P5LPR**



Date: 28.NOV.2019 14:21:28

**Fundamental Emission – 28 MHz RBW, Peak, Zero Span – P5LPR**



Industry Canada RSS-211 and Industry Canada RSS-GEN

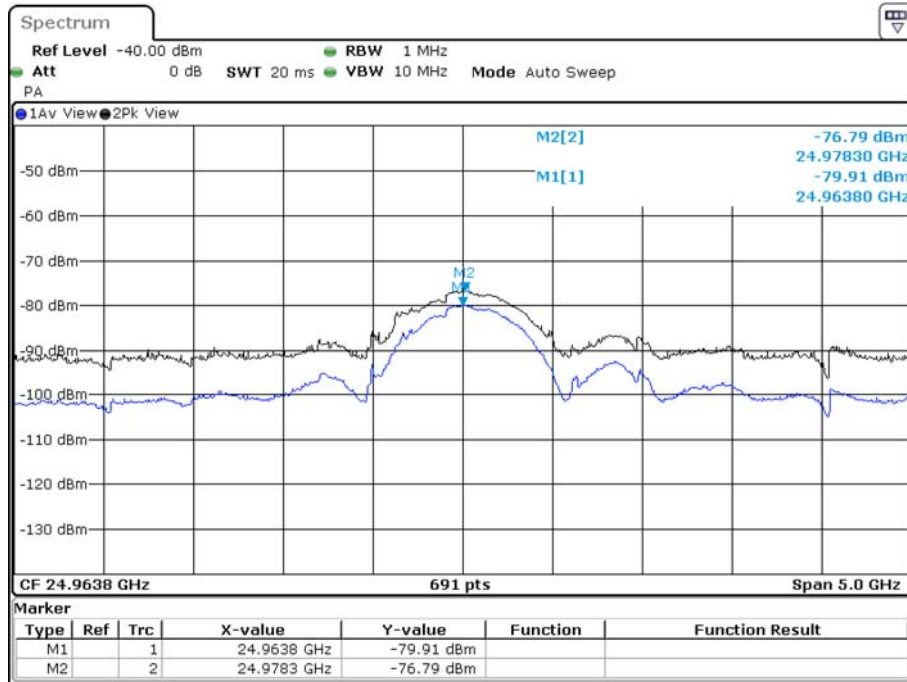
<b>Equipment Under Test</b>	<b>P2LPR</b>	<b>P4LPR</b>	<b>P5LPR</b>
<b>f Max Level (GHz)</b>	24.96380	24.99800	25.00000
<b>Average Level at 1 MHz RBW (dBm) – reading Value</b>	-79.91	-67.87	-69.39
<b>Average Level at 1 MHz RBW (dBm) – final result</b>	-35.35	-23.31	-25.99
<b>Average emission limit EIRP dBm (acc. RSS-211 chapter 5.2b)</b>	-14		
<b>Margin</b>	21.35	9.31	11.99
<b>Verdict</b>	PASS	PASS	PASS

Max Peak Signal Level was measuring with 1 MHz RBW.

The correction factor was calculated in accordance to the KDB 890966 D01 - E.5.a The bandwidth correction factor is equal to +34 dB and was added to the maximum peak value measured at 1 MHz RBW.

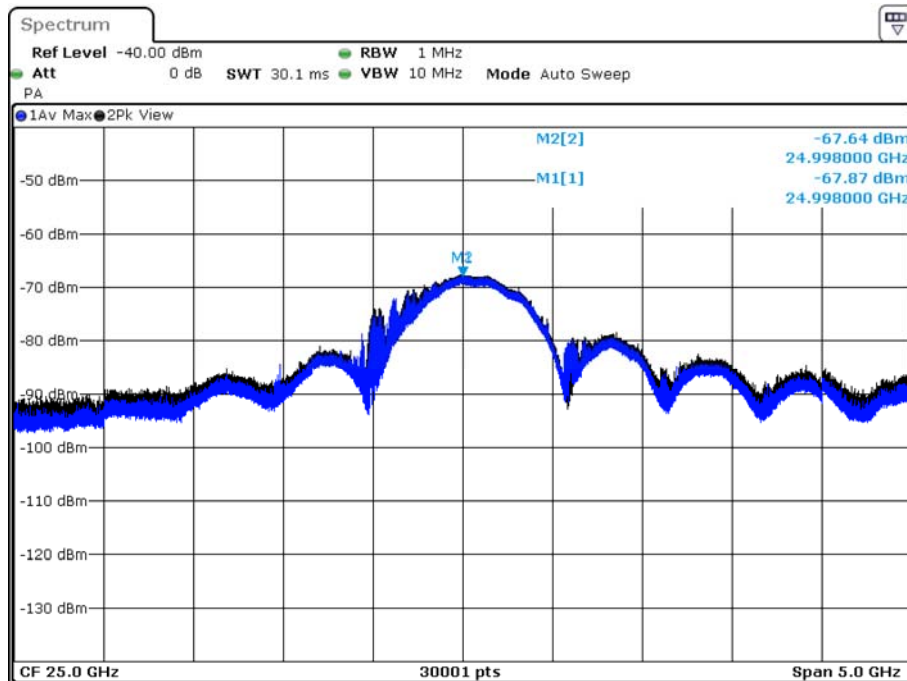
Normal operation mode: Measurement with pulsed signal:

<b>Equipment Under Test</b>	<b>P2LPR</b>	<b>P4LPR</b>	<b>P5LPR</b>
<b>f Max Level (GHz)</b>	24.97830	24.99800	25.10660
<b>Max Peak Level at 1 MHz RBW (dBm) – reading value</b>	-76.79	-67.64	-67.80
<b>Max Peak Level at 50 MHz RBW (dBm) – final result</b>	1.77	10.92	9.60
<b>Peak emission limit EIRP dBm (acc. RSS-211 chapter 5.2b)</b>	26		
<b>Margin</b>	24.23	15.08	16.4
<b>Verdict</b>	PASS	PASS	PASS



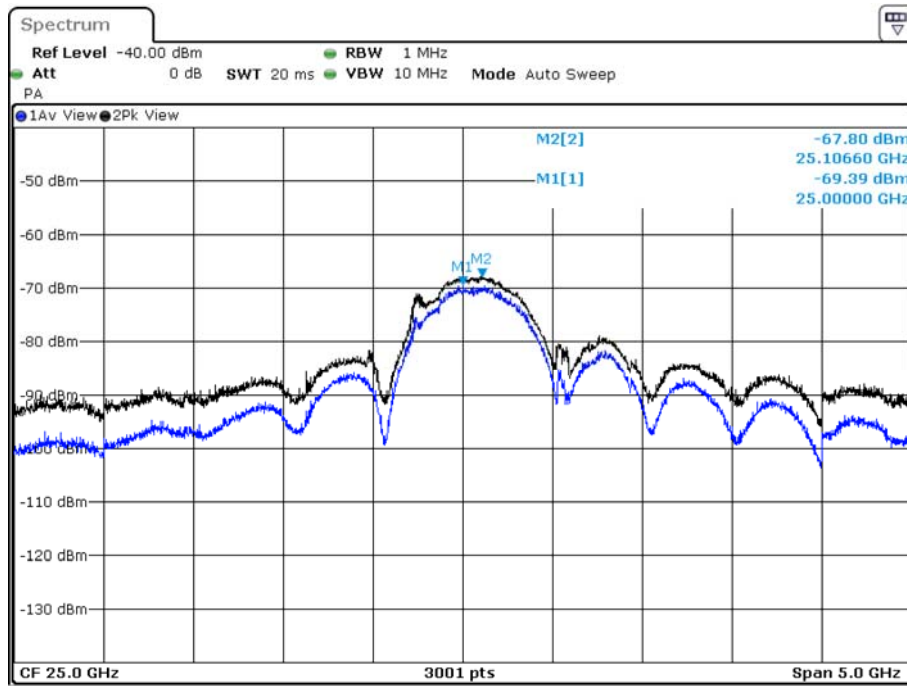
Date: 28.NOV.2019 13:29:10

**Fundamental Emission - 1MHz RBW, Average, Peak – P2LPR**



Date: 28.NOV.2019 14:48:31

**Fundamental Emission - 1MHz RBW, Average, Peak – P4LPR**



Date: 28.NOV.2019 14:06:15

**Fundamental Emission - 1MHz RBW, Average, Peak – P5LPR**





FCC 47 CFR Part 15, Limit Clause 15.256 (g)

For frequency band 24.05 to 29.00 GHz. Peak Emission Limit (EIRP in dBm Measured in 50 MHz) as Measured Boresight is +26 dBm.

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

For frequency band 24.05 to 29.00 GHz. Peak Emission Limit (EIRP in dBm Measured in 50 MHz) as Measured Boresight is +26 dBm.

**3.3.7 Test Location and Test Equipment Used**

This test was carried out in Fully Anechoic Room no. 2.

<i>T-ID</i>	<i>Designation</i>	<i>Type</i>	<i>Last Cal.</i>	<i>Next Cal.</i>
19125	Horn antenna	3160-09	Verified	
19383	Double ridged waveguide horn antenna	3115	2017-02	2020-02
19442	Horn antenna	3160-10	Verified	
19946	Horn antenna	24240-20	Verified	
22553	Waveguide mixer	FS-Z170	2016-08	2019-08
25849	Waveguide mixer	FS-Z60	2017-04	2020-04
25850	Waveguide mixer	FS-Z90	2016-12	2019-12
25851	Waveguide mixer	FS-Z110	2016-11	2019-11
27898	Horn antenna	26240-20	Verified	
27899	Horn antenna	27240-20	Verified	
39897	EMI test receiver	ESW44	2019-02	2020-02
36954	Harmonic Mixer	FS-Z220	2018-03	2021-03
36955	Harmonic Mixer	FS-Z325	2018-02	2021-02
37863	Horn antenna	30240-20 WG30	Verified	
37864	Horn antenna	32240-20 WG32	Verified	
38401	ULTRALOG Antenna	HL562E	2018-05	2021-05

**Table 9**