

Test Report

Test report no.: 21126659-24922-0

Date of issue: 2022-03-09

Test result: The test item - **passed** - and complies with the listed standards.

Applicant

Mitsubishi Electric Corporation Sanda Works

Manufacturer

Mitsubishi Electric Corporation

Test Item

R1LOW-R

Electromagnetic Compatibility Testing according to:

47 CFR Part 15

Radio frequency devices,
Subpart B – Unintentional Radiators
(§15.107, §15.109)

ICES-003 Issue 7

Information Technology Equipment
(including Digital Apparatus)
(3.1.1, 3.2.2)

Tested by
(name, function, signature)

Frank von Ehren
Lab Manager EMC



signature

Approved by
(name, function, signature)

Florian Schmidt
Head of Department EMC



signature

Applicant and Test item details	
Applicant	<i>Mitsubishi Electric Corporation Sanda Works 2-3-33, Miwa, Sanda-city, Hyogo 669-1513 Japan Phone: +81 79 559 4813 Fax: ---</i>
Manufacturer	<i>Mitsubishi Electric Corporation 2-3-33, Miwa, Sanda-city, Hyogo 669-1513 Japan Phone: +81 79 559 4813 Fax: ---</i>
Test item description	Automotive Display Audio
Model/Type reference	R1LOW-R

Disclaimer and Notes

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Within this test report, a point / comma is used as a decimal separator.
If otherwise, a detailed note is added adjoined to its use.

Decision rule: Binary Statement for Simple Acceptance Rule according ILAC-G8:09/2019

1 TABLE OF CONTENTS

1	TABLE OF CONTENTS	3
2	GENERAL INFORMATION	4
2.1	Administrative details	4
2.2	Possible test case verdicts	4
2.3	Observations	4
2.4	Opinions and interpretations	4
2.5	Revision History	5
3	ENVIRONMENTAL & TEST CONDITIONS	5
3.1	Environmental conditions	5
4	TEST STANDARDS AND REFERENCES	5
5	SUMMARY OF TEST RESULTS	6
6	EQUIPMENT UNDER TEST (EUT)	7
6.1	EUT A	7
6.2	EUT B	9
6.3	EUT C	11
7	Associated equipment (AE)	13
7.1	AE 1	13
7.2	AE 2	13
7.3	AE 3	13
7.4	AE 4	13
7.5	AE 5	14
7.6	AE 6	14
8	TEST RESULTS	15
8.1	Conducted emission	15
8.2	Radiated emission	16
9	MEASUREMENT UNCERTAINTY	25
Annex A	.....	26
Annex B	.....	32
Annex C	.....	38
Annex D	.....	44
Annex E	.....	51
1	External photographs of EUT	52
2	AE external photographs	55
Annex F	58	
1	Internal photographs of EUT	59

2 GENERAL INFORMATION

2.1 Administrative details

Testing laboratory	IBL-Lab GmbH Heinrich-Hertz-Allee 7 66386 Sankt Ingbert / Germany Fon: +49 6894 38938-0 Fax: +49 6894 38938-99 URL: www.ib-lenhardt.de E-Mail: info@ib-lenhardt.de
Accreditation	The testing laboratory is accredited by Deutsche Akkreditierungsstelle GmbH (DAkKS) in compliance with DIN EN ISO/IEC 17025:2018. Scope of testing and registration number: <ul style="list-style-type: none"> • Electromagnetic Compatibility D-PL-21375-01-02 • Electromagnetic Compatibility and Telecommunication (FCC requirements) D-PL-21375-01-03 Website DAkKS: https://www.dakks.de/ The Deutsche Akkreditierungsstelle GmbH (DAkKS) is also a signatory to the ILAC Mutual Recognition Arrangement
Testing location	IBL-Lab GmbH Heinrich-Hertz-Allee 7 66386 St. Ingbert / Germany
Date of receipt of test samples	2022-02-11
Start – End of tests	2022-02-11 – 2022-02-17

2.2 Possible test case verdicts

Test sample meets the requirements	passed
Test sample does not meet the requirements	failed
Test case does not apply to the test sample	n/a (not applicable)
Test case not performed	n/p (not performed)

2.3 Observations

No additional observations other than the reported observations within this test report have been made.

2.4 Opinions and interpretations

No appropriate opinions or interpretations according ISO/IEC 17025:2017.

2.5 Revision History

-0 Initial Version

3 ENVIRONMENTAL & TEST CONDITIONS

3.1 Environmental conditions

Temperature	20°C ± 5°C (see below)
Relative humidity	25-75% r.H. (see below)
Barometric Pressure	860-1060 mbar

4 TEST STANDARDS AND REFERENCES

Test standard (accredited)	Description
47 CFR Part 15	Radio frequency devices, Subpart B – Unintentional Radiators (§15.107, §15.109)
ICES-003 Issue 7	Information Technology Equipment (including Digital Apparatus) (3.1.1, 3.2.2)

Reference	Description
ANSI C63.4-2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10-2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

5 SUMMARY OF TEST RESULTS

Test specification

FCC 47 CFR Part 15
ICES-003 Issue 7

Clause	Requirement / Test case	Chapter	Test Conditions	Result / Remark	Verdict
FCC: §15.107 ICES: 3.2.2	Conducted limits	8.1	normal	Class B	n/a
FCC: §15.109 ICES: 3.2.2	Radiated emission limits	8.2	normal	Class B	passed

Comments and observations

6 EQUIPMENT UNDER TEST (EUT)

6.1 EUT A

6.1.1 Product description*

Test item description*	Automotive Display Audio																																																				
Function overview*	<table border="1"> <thead> <tr> <th>Ele-Variant</th> <th>Mecha-Variant</th> <th>ID #</th> <th>Model Name</th> <th colspan="3">DDR*1)</th> <th colspan="3">UFS*2)</th> <th>SXM*3)</th> <th>DAB</th> <th>FM2</th> <th>2nd USB</th> <th>Ethernet</th> <th>Digital RVCs</th> <th>Analog RVC*4)</th> <th>B CAN Term.</th> <th>C CAN Term.</th> </tr> </thead> <tbody> <tr> <td>10</td> <td>8TR</td> <td>50</td> <td>R1LOW-R</td> <td>4GB</td> <td>95</td> <td>SK Hynix</td> <td>32GB</td> <td>95</td> <td>Samsung</td> <td>X</td> <td>-</td> <td>-</td> <td>X</td> <td>-</td> <td>2</td> <td>2</td> <td>X</td> <td>X</td> </tr> </tbody> </table> <p>*1) Main Memory *2) Universal Flash Storage *3) SiriusXM *4) Rear View Camera</p>															Ele-Variant	Mecha-Variant	ID #	Model Name	DDR*1)			UFS*2)			SXM*3)	DAB	FM2	2nd USB	Ethernet	Digital RVCs	Analog RVC*4)	B CAN Term.	C CAN Term.	10	8TR	50	R1LOW-R	4GB	95	SK Hynix	32GB	95	Samsung	X	-	-	X	-	2	2	X	X
Ele-Variant	Mecha-Variant	ID #	Model Name	DDR*1)			UFS*2)			SXM*3)	DAB	FM2	2nd USB	Ethernet	Digital RVCs	Analog RVC*4)	B CAN Term.	C CAN Term.																																			
10	8TR	50	R1LOW-R	4GB	95	SK Hynix	32GB	95	Samsung	X	-	-	X	-	2	2	X	X																																			

*: as declared by applicant

6.1.2 Description of test item

Model name*	R1LOW-R
EUT status*	PV
Serial number*	X0342
Control number*	50
PCB identifier*	N211J71610
Hardware status*	NR-0C-R-PV
Software status*	Android 10

*: as declared by applicant

6.1.3 Additional information

The analogue RVC was only terminated during test.

6.1.4 Technical data of test item		
Operational frequency band*	Bluetooth and Bluetooth LE: 2402 - 2480 MHz Car radio: AM: 531~1611 kHz FM: 87.5~108.0 MHz GPS/GLONASS/BeiDou/Galileo: GPS: 1575.42 MHz GLONASS: 1597.5515~1605.886 MHz BeiDou: 1559.052~1563.144 MHz Galileo: 1575.42 MHz WLAN 2.4 GHz band: 2412 - 2472 MHz WLAN 5 GHz band: 5180 - 5240 MHz 5260 - 5320 MHz 5500 - 5720 MHz 5745 - 5825 MHz	
Power supply*	battery powered (9 V – 16.5 V)	
Nominal supply voltage*	DC 12.6 V	
Ports*	Classification*	Direction*
	DC mains	input
	Signal/control (vehicle cable harness)	in/output
	Signal/control (digital RVC)	in/output
	Signal/control (analog RVC)	in/output
	Signal/control (USB)	input
	Antenna (FM/AM)	input
	Antenna (GNSS)	in/output

*: as declared by applicant

6.1.5 Operation Modes during test	
Operation mode 1 (op.1)	Active RVC and continuous reception of a 400 Hz sine wave tone over FM radio.
Operation mode 2 (op.2)	Active RVC; continuous reception of a 400 Hz sine wave tone sent by a plugged media player over USB; unused ports terminated; WLAN, BT idle

6.2 EUT B

6.2.1 Product description*

Test item description*	Automotive Display Audio																																																					
Function overview*	<table border="1"> <thead> <tr> <th>Ele-Variant</th> <th>Mecha-Variant</th> <th>ID #</th> <th>Model Name</th> <th colspan="3">DDR*1)</th> <th colspan="3">UFS*2)</th> <th>SXM*3)</th> <th>DAB</th> <th>FM2</th> <th>2nd USB</th> <th>Ethernet</th> <th>Digital RVCs</th> <th>Analog RVC*4)</th> <th>B CAN Term.</th> <th>C CAN Term.</th> </tr> </thead> <tbody> <tr> <td>20</td> <td>8TR</td> <td>52</td> <td>R1LOW-R</td> <td>4GB</td> <td>95</td> <td>SK Hynix</td> <td>32GB</td> <td>95</td> <td>Samsung</td> <td>-</td> <td>-</td> <td>-</td> <td>X</td> <td>-</td> <td>2</td> <td>2</td> <td>X</td> <td>X</td> </tr> </tbody> </table> <p>*1) Main Memory *2) Universal Flash Storage *3) SiriusXM *4) Rear View Camera</p>																Ele-Variant	Mecha-Variant	ID #	Model Name	DDR*1)			UFS*2)			SXM*3)	DAB	FM2	2nd USB	Ethernet	Digital RVCs	Analog RVC*4)	B CAN Term.	C CAN Term.	20	8TR	52	R1LOW-R	4GB	95	SK Hynix	32GB	95	Samsung	-	-	-	X	-	2	2	X	X
Ele-Variant	Mecha-Variant	ID #	Model Name	DDR*1)			UFS*2)			SXM*3)	DAB	FM2	2nd USB	Ethernet	Digital RVCs	Analog RVC*4)	B CAN Term.	C CAN Term.																																				
20	8TR	52	R1LOW-R	4GB	95	SK Hynix	32GB	95	Samsung	-	-	-	X	-	2	2	X	X																																				

*: as declared by applicant

6.2.2 Description of test item

Model name*	R1LOW-R
EUT status*	PV
Serial number*	X0140
Control number*	52
PCB identifier*	N211J71610
Hardware status*	NR-0C-R-PV
Software status*	Android 10

*: as declared by applicant

6.2.3 Additional information

The analogue RVC was only terminated during test.

6.2.4 Technical data of test item		
Operational frequency band*	Bluetooth and Bluetooth LE: 2402 - 2480 MHz Car radio: AM: 531~1611 kHz FM: 87.5~108.0 MHz GPS/GLONASS/BeiDou/Galileo: GPS: 1575.42 MHz GLONASS: 1597.5515~1605.886 MHz BeiDou: 1559.052~1563.144 MHz Galileo: 1575.42 MHz WLAN 2.4 GHz band: 2412 - 2472 MHz WLAN 5 GHz band: 5180 - 5240 MHz 5260 - 5320 MHz 5500 - 5720 MHz 5745 - 5825 MHz	
Power supply*	battery powered (9 V – 16.5 V)	
Nominal supply voltage*	DC 12.6 V	
Ports*	Classification*	Direction*
	DC mains	input
	Signal/control (vehicle cable harness)	in/output
	Signal/control (digital RVC)	in/output
	Signal/control (analog RVC)	in/output
	Signal/control (USB)	input
	Antenna (FM/AM)	input
	Antenna (GNSS)	in/output

*: as declared by applicant

6.2.5 Operation Modes during test	
Operation mode 1 (op.1)	Active RVC and continuous reception of a 400 Hz sine wave tone over FM radio.
Operation mode 2 (op.2)	Active RVC; continuous reception of a 400 Hz sine wave tone sent by a plugged media player over USB; unused ports terminated; WLAN, BT idle

6.3 EUT C

6.3.1 Product description*

Test item description*	Automotive Display Audio																																																						
Function overview*	<table border="1"> <thead> <tr> <th>Ele-Variant</th> <th>Mecha-Variant</th> <th>ID #</th> <th>Model Name</th> <th colspan="3">DDR*1)</th> <th colspan="3">UFS*2)</th> <th>SXM*3)</th> <th>DAB</th> <th>FM2</th> <th>2nd USB</th> <th>Ethernet</th> <th>Digital RVCs</th> <th>Analog RVC*4)</th> <th>B CAN Term.</th> <th>C CAN Term.</th> </tr> </thead> <tbody> <tr> <td>10</td> <td>7ICS</td> <td>56</td> <td>R1LOW-R</td> <td>4GB</td> <td>95</td> <td>SK Hynix</td> <td>32GB</td> <td>95</td> <td>Samsung</td> <td>X</td> <td>-</td> <td>-</td> <td>X</td> <td>-</td> <td>2</td> <td>2</td> <td>X</td> <td>X</td> </tr> </tbody> </table> <p>*1) Main Memory *2) Universal Flash Storage *3) SiriusXM *4) Rear View Camera</p>																	Ele-Variant	Mecha-Variant	ID #	Model Name	DDR*1)			UFS*2)			SXM*3)	DAB	FM2	2nd USB	Ethernet	Digital RVCs	Analog RVC*4)	B CAN Term.	C CAN Term.	10	7ICS	56	R1LOW-R	4GB	95	SK Hynix	32GB	95	Samsung	X	-	-	X	-	2	2	X	X
Ele-Variant	Mecha-Variant	ID #	Model Name	DDR*1)			UFS*2)			SXM*3)	DAB	FM2	2nd USB	Ethernet	Digital RVCs	Analog RVC*4)	B CAN Term.	C CAN Term.																																					
10	7ICS	56	R1LOW-R	4GB	95	SK Hynix	32GB	95	Samsung	X	-	-	X	-	2	2	X	X																																					

*: as declared by applicant

6.3.2 Description of test item

Model name*	R1LOW-R
EUT status*	PV
Serial number*	R0094
Control number*	56
PCB identifier*	N211J71610
Hardware status*	NR-0C-R-PV
Software status*	Android 10

*: as declared by applicant

6.3.3 Additional information

The analogue RVC was only terminated during test.

6.3.4 Technical data of test item		
Operational frequency band*	Bluetooth and Bluetooth LE: 2402 - 2480 MHz Car radio: AM: 531~1611 kHz FM: 87.5~108.0 MHz GPS/GLONASS/BeiDou/Galileo: GPS: 1575.42 MHz GLONASS: 1597.5515~1605.886 MHz BeiDou: 1559.052~1563.144 MHz Galileo: 1575.42 MHz WLAN 2.4 GHz band: 2412 - 2472 MHz WLAN 5 GHz band: 5180 - 5240 MHz 5260 - 5320 MHz 5500 - 5720 MHz 5745 - 5825 MHz	
Power supply*	battery powered (9 V – 16.5 V)	
Nominal supply voltage*	DC 12.6 V	
Ports*	Classification*	Direction*
	DC mains	input
	Signal/control (vehicle cable harness)	in/output
	Signal/control (digital RVC)	in/output
	Signal/control (analog RVC)	in/output
	Signal/control (USB)	input
	Antenna (FM/AM)	input
	Antenna (GNSS)	in/output

*: as declared by applicant

6.3.5 Operation Modes during test	
Operation mode 1 (op.1)	Active RVC and continuous reception of a 400 Hz sine wave tone over FM radio.
Operation mode 2 (op.2)	Active RVC; continuous reception of a 400 Hz sine wave tone sent by a plugged media player over USB; unused ports terminated; WLAN, BT idle

7 Associated equipment (AE)

7.1 AE 1

Product description*

GPS antenna

Description*

Frequency:	1575.42 MHz
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Voltage:	3 V – 5 V
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Hardware status	---
-----------------	-----

Software status	---
-----------------	-----

7.2 AE 2

Product description*

DAB antenna (Delock12412)

Description*

Frequency:	174 MHz – 240 MHz
------------	-------------------

Gain:	5 dBi
-------	-------

Hardware status	---
-----------------	-----

Software status	---
-----------------	-----

7.3 AE 3

Product description*

Digital camera (RVC)

Description*

Model name:	---
-------------	-----

Serial number:	C110001921601887
----------------	------------------

Hardware status	170100
-----------------	--------

Software status	182500 E179127 A
-----------------	------------------

7.4 AE 4

Product description*

USB HUB

Description*

Model name:	---
-------------	-----

Serial number:	---
----------------	-----

Hardware status	---
-----------------	-----

Software status	---
-----------------	-----

7.5 AE 5	
Product description*	
CAN Tool 2	
Description*	
Model name:	CT2E1001-5HNLT
Serial number:	15G1368B
Hardware status	---
Software status	---

7.6 AE 6	
Product description*	
Termination jig	
Description*	
Model name:	---
Serial number:	---
Hardware status	---
Software status	---

8 TEST RESULTS

8.1 Conducted emission

Not performed. Vehicular equipment.

8.2 Radiated emission

8.2.1 Test plan (op. 1)

Test setup	EUT A + AE 1 + AE 2 + AE 3 + AE 4 + AE 5 + AE 6; EUT B + AE 1 + AE 2 + AE 3 + AE 4 + AE 5 + AE 6; EUT C + AE 1 + AE 2 + AE 3 + AE 4 + AE 5 + AE 6;
Operating mode	Operating Mode 1 (op. 1)
Limit	FCC: §15.109 Class B ICES: 3.2.2 Class B
Verdict	passed

Comment: Associated equipment depends on the placement

8.2.2 Test plan (op. 2)

Test setup	EUT A + AE 1 + AE 2 + AE 3 + AE 4 + AE 5 + AE 6; EUT B + AE 1 + AE 2 + AE 3 + AE 4 + AE 5 + AE 6; EUT C + AE 1 + AE 2 + AE 3 + AE 4 + AE 5 + AE 6;
Operating mode	Operating Mode 2 (op. 2)
Limit	FCC: §15.109 Class B ICES: 3.2.2 Class B
Verdict	passed *

Comment: Associated equipment depends on the placement

8.2.3 Radiated emission limits (§15.109)

Description & Limits

§ 15.109 Radiated emission limits.

(a) Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency [MHz]	Field Strength [$\mu\text{V/m}$] / [dB $\mu\text{V/m}$]	Measurement distance [m]
30 – 88	100 / 40.0	3
88 – 216	150 / 43.5	3
216 – 960	200 / 46.0	3
960 – 40 000	500 / 54.0	3

(b) The field strength of radiated emissions from a Class A digital device, as determined at a distance of 10 meters, shall not exceed the following:

Frequency [MHz]	Field Strength [$\mu\text{V/m}$] / [dB $\mu\text{V/m}$]	Measurement distance [m]
30 – 88	90 / 39.1	3
88 – 216	150 / 43.5	3
216 – 960	210 / 46.4	3
960 – 40 000	300 / 49.5	3

Note

Measurements with the peak detector are also suitable to demonstrate compliance of an EUT, as long as the required resolution bandwidth is used, because peak detection will yield amplitudes equal to or greater than amplitudes measured with RMS detector. The measurement data from a spectrum analyser peak detector will represent the worst-case results (see ANSI C63.10).

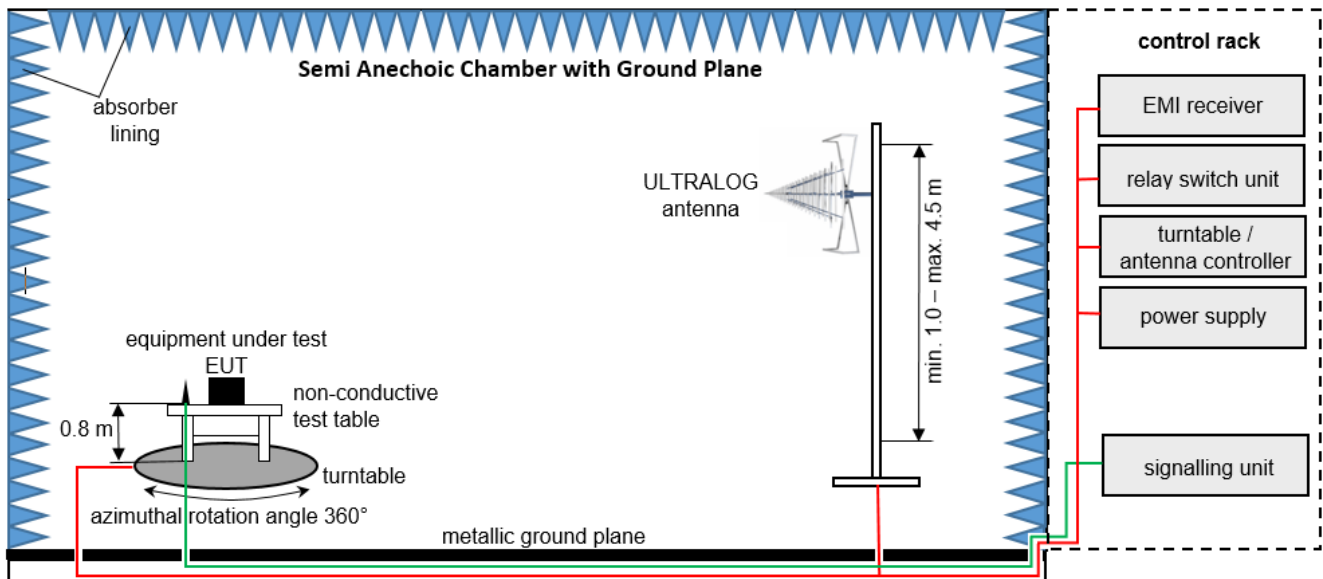
Typical test distances

Up to 18 GHz: 3.00 m
 18 – 40 GHz: 0.50 m

8.2.4 Test Setup Description

8.2.4.1 Semi Anechoic Chamber with Ground Plane

Radiated measurements are performed in vertical and horizontal plane in the frequency range 30 MHz to 1 GHz in a Semi Anechoic Chamber with a metallic ground plane. The EUT is positioned on a non-conductive test table with a height of 0.80 m above the metallic ground plane that covers the whole chamber. The receiving antennas conform to specification ANSI C63.10-2013, American National Standard for Testing Unlicensed Wireless Devices. These antennas can be moved over the height range between 1.0 m and 4.5 m in order to search for maximum field strength emitted from the EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received. The wanted and unwanted emissions are received by a spectrum analyzer where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.



Measurement distance: ULTRALOG antenna 3 meter
 EMC32 software version: 11.10.00

FS = UR + CL + AF
 (FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

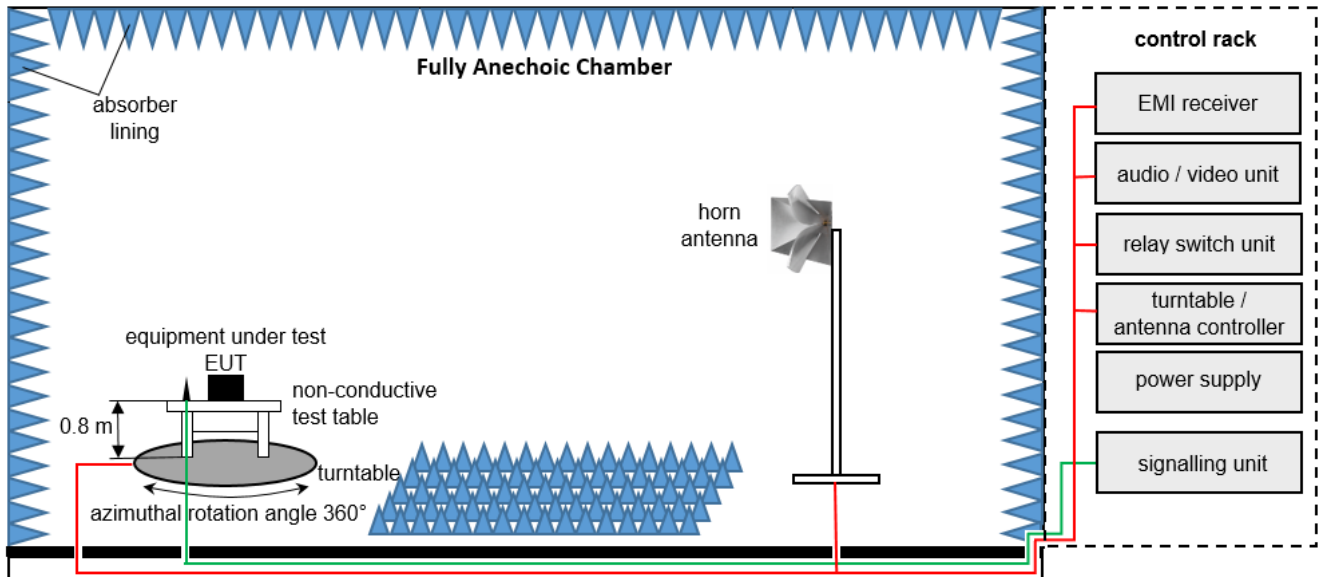
Example calculation:

FS [dBµV/m] = 12.35 [dBµV/m] + 1.90 [dB] + 16.80 [dB/m] = 31.05 [dBµV/m] (35.69 µV/m)

List of test equipment used:

#	Equipment	Type	Serial number	Internal number	Calibrated until	Used for test
1	EMI Test Receiver	Rohde & Schwarz ESW 26	101481	LAB000236	2022-07-01	☒
2	Open Switch and Control Platform	Rohde & Schwarz OSP-B200S2	101443	LAB000239	n/a	☒
3	Antenna	Rohde & Schwarz HL562E	102001	LAB000123	2023-07-05	☒

8.2.4.2 Fully Anechoic Chamber



Measurement distance: horn antenna 3 meter
 EMC32 software version: 11.10.00

FS = UR + CA + AF
 (FS-field strength; UR-voltage at the receiver; CA-loss of the signal path; AF-antenna factor)

Example calculation:

$$FS [dB\mu V/m] = 40.0 [dB\mu V/m] + (-35.8) [dB] + 32.9 [dB/m] = 37.1 [dB\mu V/m] (71.61 \mu V/m)$$

List of test equipment used:

#	Equipment	Type	Serial number	Internal number	Calibrated until	Used for test
1	EMI Test Receiver	Rohde & Schwarz ESW 26	101481	LAB000236	2022-07-01	<input checked="" type="checkbox"/>
2	Open Switch and Control Platform	Rohde & Schwarz OSP-B200S2	101443	LAB000239	n/a	<input checked="" type="checkbox"/>
3	Antenna	Rohde & Schwarz HF907	102899	LAB000151	2023-04-23	<input checked="" type="checkbox"/>
4	Pre-Amplifier	Schwarzbeck BBV 9718 C	84	LAB000169	n/a	<input checked="" type="checkbox"/>

8.2.5 Test Setup Description

8.2.5.1 Radiated spurious emissions from 30 MHz to 1 GHz

Test setup

- The EUT is set up according to its intended use, as described in the user manual or as defined by the manufacturer.
- In case of floor standing equipment, it is placed in the middle of the turn table.
In case of tabletop equipment it is placed on a non-conductive table with a height of 80 cm.
- Additional equipment, cables, ... necessary for testing, are positioned like under normal operation.
- Interface cables, e.g. power supply, network, ... are connected to the connection box in the turn table.
- EUT is powered on and set into operation.

Pre-scan

- Turntable performs an azimuthal rotation from 0° to 315° in 45° steps.
- Antenna polarisation is changed (H-V / V-H) and antenna height is changed from 1 meter to 4 meters.
- For each turntable step / antenna polarisation / antenna height the EMI-receiver/spectrum analyser performs a positive-peak/max-hold sweep (=worst-case). Data is transferred to EMI-software and recorded. EMI-software will show the maximum level of all single sweeps as the final result for the pre-scan.

Final measurement

- Significant emissions found during the pre-scan will be maximized by the EMI-software based on evaluated data during the pre-scan by rotating the turntable and changing antenna height and polarisation.
- Final measurement will be performed with measuring equipment settings as defined in the applicable test standards (e.g. ANSI C63.4).
- Plot of the pre-scan with frequencies of identified emissions including levels, correction factors, turn table position, antenna polarisation and settings of measuring equipment is recorded.

Detailed requirements can be found in e.g. ANSI C63.4

8.2.5.2 Radiated spurious emissions from 1 GHz to 18 GHz

Test setup

- The EUT is set up according to its intended use, as described in the user manual or as defined by the manufacturer.
- In case of floor standing equipment, it is placed in the middle of the turn table.
In case of tabletop equipment it is placed on a non-conductive table with a height of 80 cm.
- Additional equipment, cables, ... necessary for testing, are positioned like under normal operation.
- Interface cables, e.g. power supply, network, ... are connected to the connection box in the turn table.
- EUT is powered on and set into operation.

Pre-scan

- Turntable performs an azimuthal rotation from 0° to 315° in 45° steps.
- Antenna polarisation is changed (H-V / V-H) and antenna height is changed from 1 meter to 4 meters.
- For each turntable step / antenna polarisation / antenna height the EMI-receiver/spectrum analyser performs a positive-peak/max-hold sweep (=worst-case). Data is transferred to EMI-software and recorded. EMI-software will show the maximum level of all single sweeps as the final result for the pre-scan.

Final measurement

- Significant emissions found during the pre-scan will be maximized by the EMI-software based on evaluated data during the pre-scan by rotating the turntable and changing antenna height and polarisation.
- Final measurement will be performed with measuring equipment settings as defined in the applicable test standards (e.g. ANSI C63.4).
- Plot of the pre-scan with frequencies of identified emissions including levels, correction factors, turn table position, antenna polarisation and settings of measuring equipment is recorded.

Detailed requirements can be found in e.g. ANSI C63.4

8.2.5.3 Radiated spurious emissions above 18 GHz

Test setup

- The EUT is set up according to its intended use, as described in the user manual or as defined by the manufacturer.
- Additional equipment, cables, ... necessary for testing, are positioned like under normal operation.
- EUT is powered on and set into operation.
- Test distance depends on EUT size and test antenna size (farfield conditions shall be met).

Pre-scan

- The test antenna is handheld and moved carefully over the EUT to cover the EUT's whole sphere and for different polarizations of the antenna.

Final measurement

- Significant emissions found during the pre-scan will be maximized, i.e. position and antenna orientation causing the highest emissions with Peak and RMS detector
- Final measurement will be performed with measuring equipment settings as defined in the applicable test standards (e.g. ANSI C63.4).
- Final plot showing measurement data, levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit is recorded.

Note

- In case of measurements with external harmonic mixers (e.g. above 50 GHz) special care is taken to avoid possible overloading of the external mixer's input.
- As external harmonic mixers may generate false images, care is taken to ensure that any emission measured by the spectrum analyzer is indeed radiated from the EUT and not internally generated by the external harmonic mixer. Signal identification feature of spectrum analyzer is used to eliminate/reduce images of the external harmonic mixer.

Detailed requirements can be found in e.g. ANSI C63.4

8.2.6 Measurement results (op. 1)

refer to:

- Annex A
- Annex B
- Annex C

8.2.7 Measurement results (op. 2)

refer to:

- Annex A
- Annex B
- Annex C

9 MEASUREMENT UNCERTAINTY

#	Test	Measurement uncertainty
1	Conducted emissions CISPR 16-4-2	2.21 dB
2	Radiated emissions CISPR 16-4-2	30 ... 1000 MHz 3.68dB 1 ... 18 GHz 3.64 dB
3	Harmonics / Flicker EN / IEC 61000-4-15	Current AC 350uA-320mA / 50Hz-5kHz 0.24 % Current AC 350mA-2.2A / 50Hz-5kHz 0.40 % Current AC 2.5A-10A / 50Hz-1kHz 0.27 % Current AC 2A-80A / 50Hz-1kHz 0.20 % Resistor DC 0.23 % Inductance 0.23 % Short-term flicker severity 0.24 % Maximum steady state voltage 0.24 % Maximum absolute voltage change 0.24 % Maximum time duration during observation 0.24 % Voltage AC 1V-1000V / 16Hz-10kHz 0.20 %
4	Radio frequency electromagnetic field EN / IEC 61000-4-3	1.98 dB
5	Electrical fast transients / Burst EN / IEC 61000-4-4	Peak Voltage 6.05 % Rise time 186 ps Duration 1602 ps Frequency oscilloscope 0.014 %
6	Surges EN / IEC 61000-4-5	Peak current 3.67 % Front & Rise time 76000 ps Duration 76000 ps Frequency oscilloscope 0.014 % Peak voltage 4.87 % Front & Rise time 4600 ps Duration 4600 ps
7	Conducted disturbances EN / IEC 61000-4-6	3.47 dB
8	Voltage dips and interruptions EN / IEC 61000-4-11	Voltage AC 1mV-1000V 4.95 % Current AC 3.82 % Inrush Current 3.71 % Rise / Fall time 18.4 ns Duration 46000 ps

END OF TEST REPORT

Annex A

Measurements results of EUT A

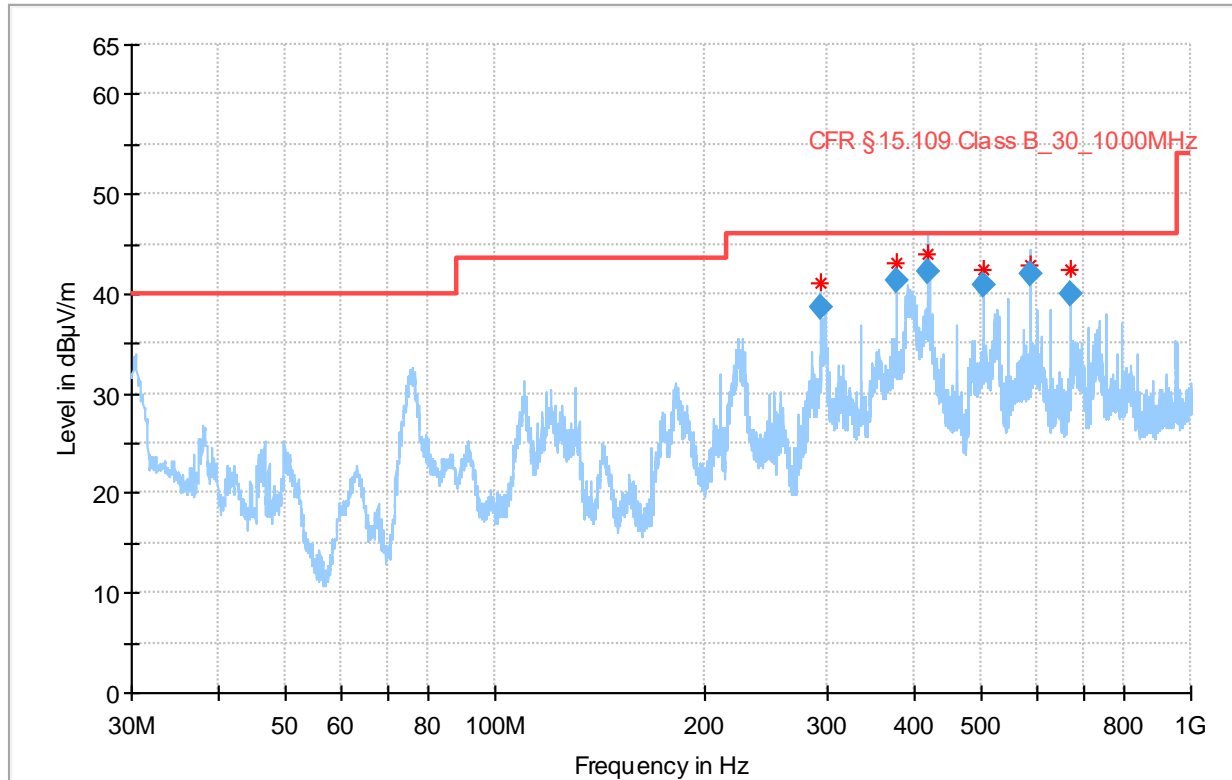
part of / in addition to

Test report no.: 21126659-24922-0

Date of issue: 2022-03-09

1.1 Electromagnetic radiated emission (30 ... 1000 MHz)

Full Spectrum

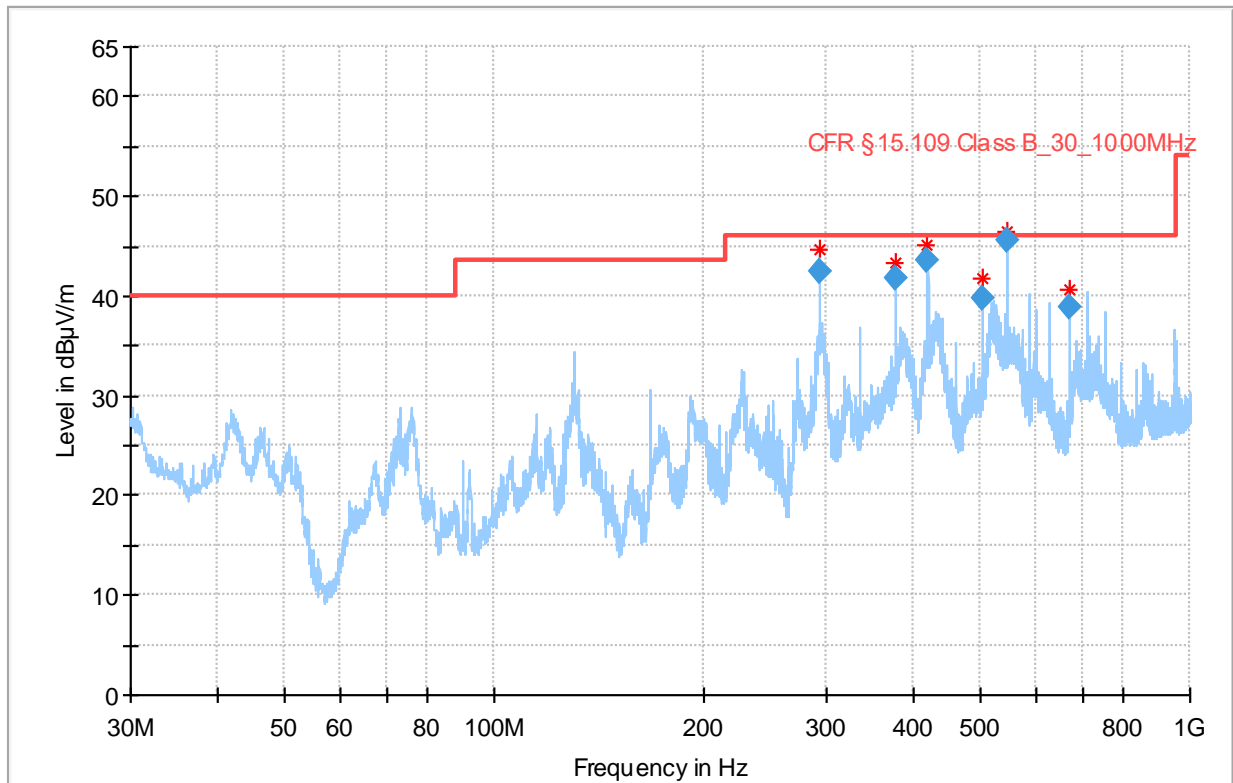


— Preview Result 1-PK+ * Critical_Freqs PK+
— CFR §15.109 Class B_30_1000MHz ◆ Final_Result QPK

Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
294.000000	38.69	46.00	7.31	15000.0	120.000	100.0	V	26.0	13.7
378.000000	41.33	46.00	4.67	15000.0	120.000	100.0	H	164.0	15.9
420.000000	42.25	46.00	3.75	15000.0	120.000	111.0	H	146.0	17.0
504.000000	40.92	46.00	5.08	15000.0	120.000	100.0	V	132.0	18.9
588.000000	41.97	46.00	4.03	15000.0	120.000	130.0	H	118.0	20.2
672.000000	39.93	46.00	6.07	15000.0	120.000	103.0	H	17.0	21.4

Full Spectrum



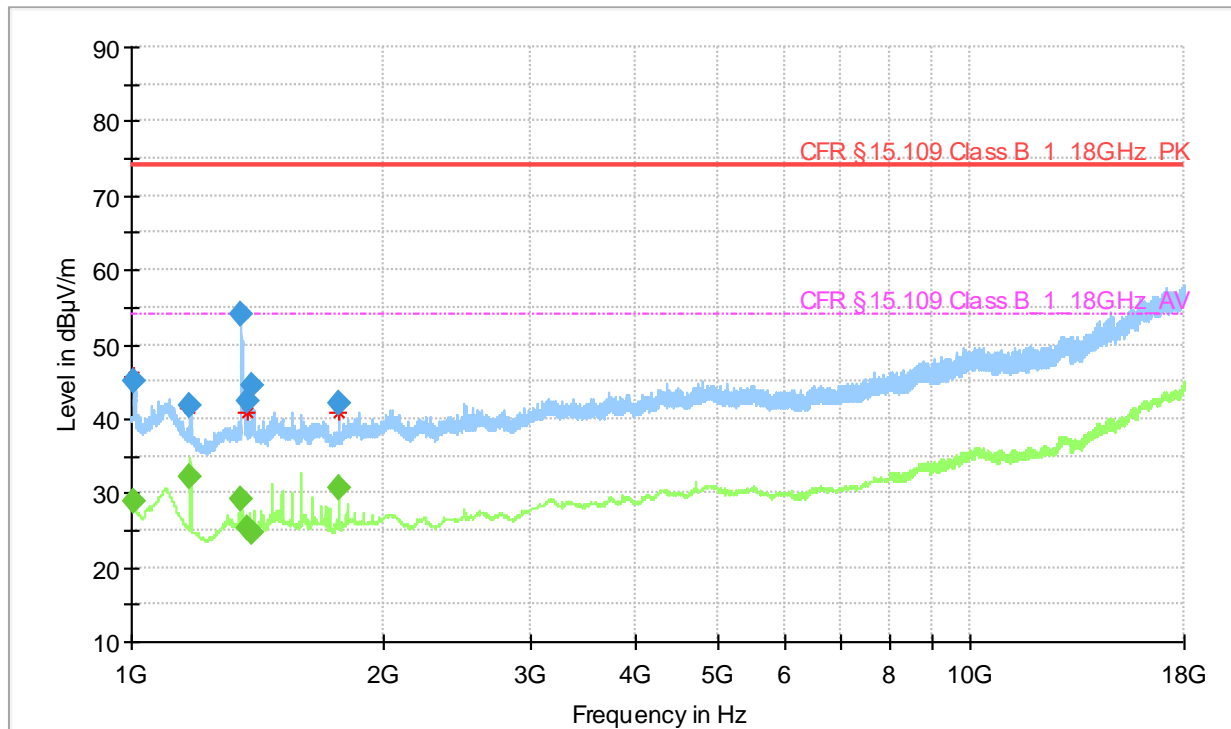
- Preview Result 1-PK+
- CFR §15.109 Class B_30_1000MHz
- ◆ Critical_Freqs PK+
- * Final_Result QPK

Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
294.000000	42.42	46.00	3.58	15000.0	120.000	100.0	V	237.0	13.7
378.000000	41.67	46.00	4.33	15000.0	120.000	103.0	H	77.0	15.9
420.000000	43.54	46.00	2.46	15000.0	120.000	104.0	H	96.0	17.0
504.000000	39.83	46.00	6.17	15000.0	120.000	100.0	H	25.0	18.9
546.000000	45.55	46.00	0.45	15000.0	120.000	103.0	H	17.0	19.3
672.000000	38.84	46.00	7.16	15000.0	120.000	103.0	H	-20.0	21.4

1.2 Electromagnetic radiated emission (1 ... 18 GHz)

Full Spectrum

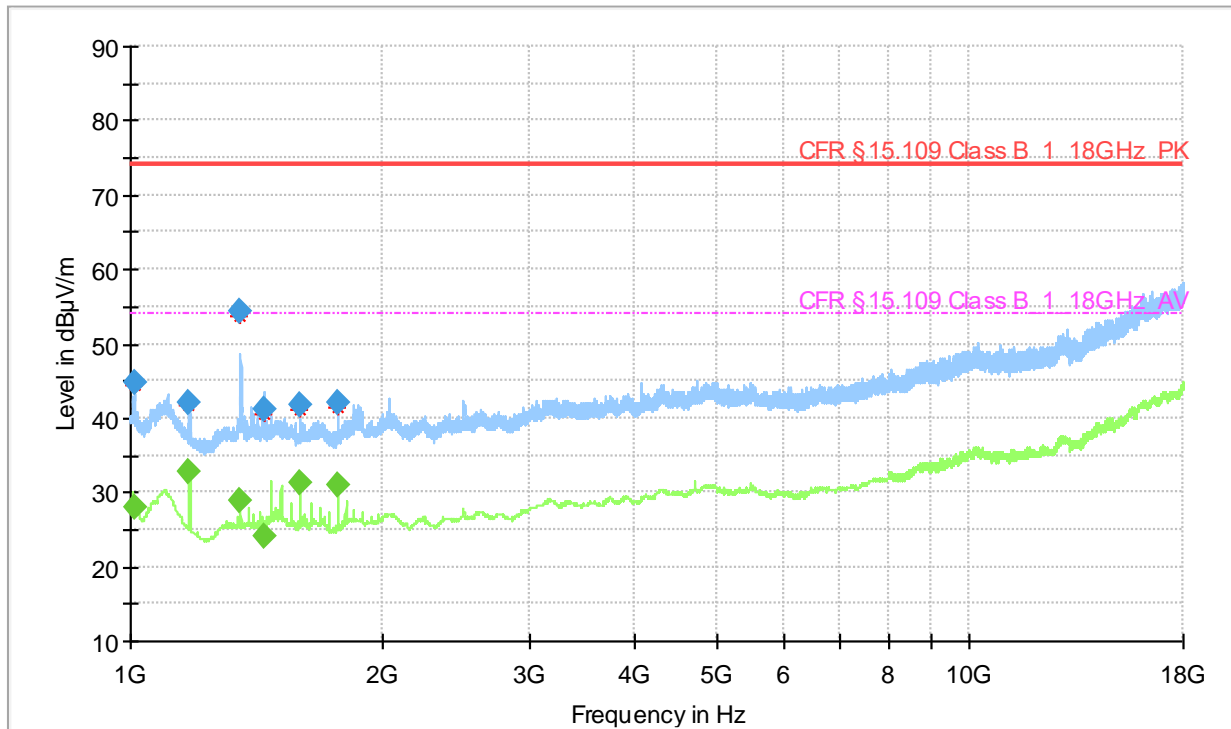


- Preview Result 2-AVG
- Preview Result 1-PK+
- * Critical_Freqs AVG
- * Critical_Freqs PK+
- CFR §15.109 Class B_1_18GHz_PK
- - - CFR §15.109 Class B_1_18GHz_AV
- ◆ Final_Result PK+
- ◆ Final_Result AVG

Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
1007.750000	---	28.94	54.00	25.06	15000.0	1000.000	V	34.0	-3.0
1007.750000	45.07	---	74.00	28.93	15000.0	1000.000	V	34.0	-3.0
1176.000000	41.78	---	74.00	32.22	15000.0	1000.000	H	248.0	-2.8
1176.000000	---	32.07	54.00	21.93	15000.0	1000.000	H	248.0	-2.8
1353.500000	54.18	---	74.00	19.82	15000.0	1000.000	H	159.0	-1.7
1353.500000	---	29.09	54.00	24.91	15000.0	1000.000	H	159.0	-1.7
1376.250000	42.35	---	74.00	31.65	15000.0	1000.000	H	144.0	-1.7
1376.250000	---	25.17	54.00	28.83	15000.0	1000.000	H	144.0	-1.7
1396.000000	44.41	---	74.00	29.59	15000.0	1000.000	H	224.0	-1.6
1396.000000	---	24.68	54.00	29.32	15000.0	1000.000	H	224.0	-1.6
1764.000000	---	30.78	54.00	23.22	15000.0	1000.000	V	254.0	0.3
1764.000000	42.07	---	74.00	31.93	15000.0	1000.000	V	254.0	0.3

Full Spectrum

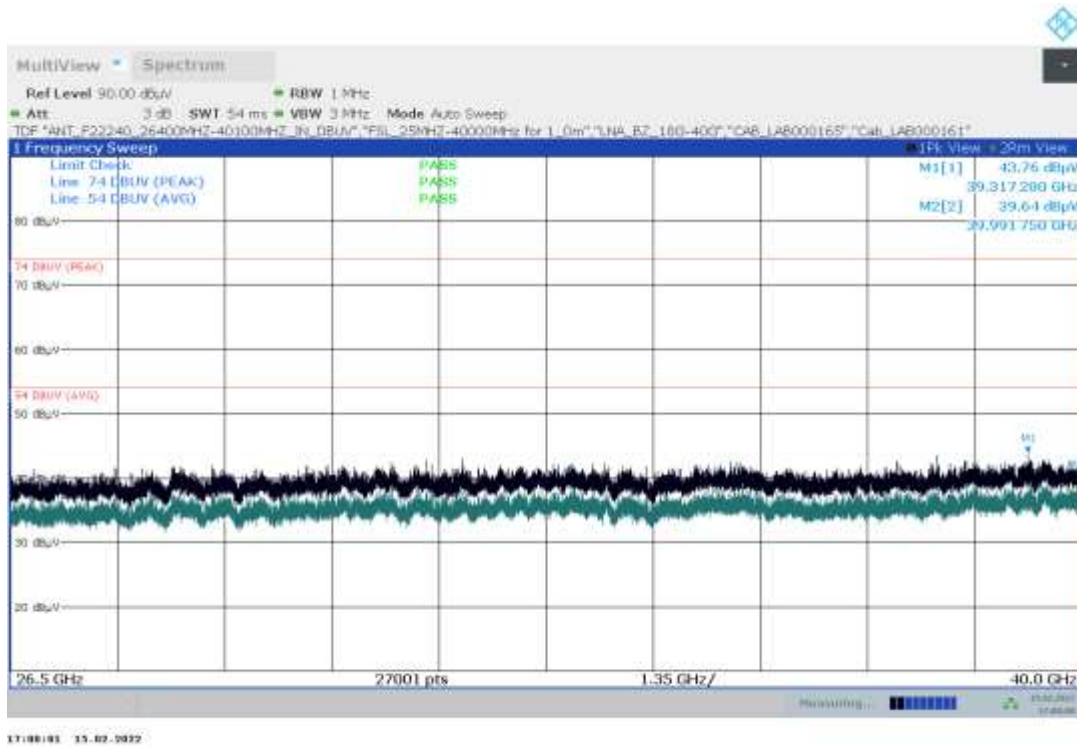
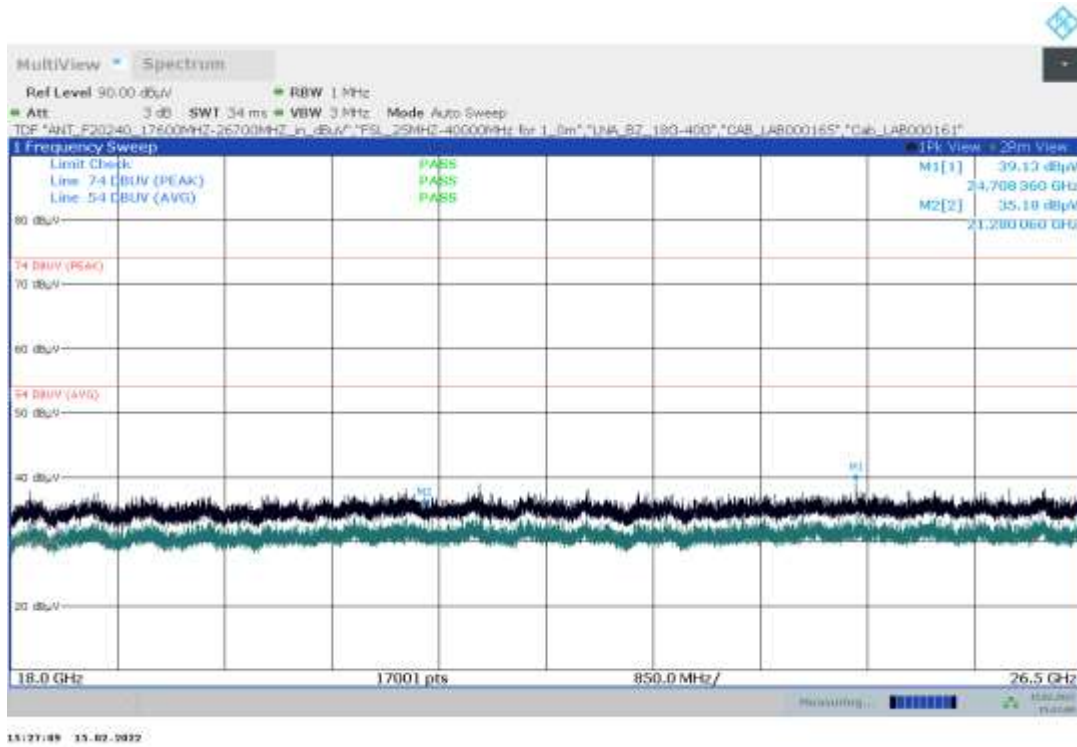


- Preview Result 2-AVG
- Preview Result 1-PK+
- * Critical_Freqs AVG
- * Critical_Freqs PK+
- CFR §15.109 Class B_1_18GHz_PK
- CFR §15.109 Class B_1_18GHz_AV
- ◆ Final_Result PK+
- ◆ Final_Result AVG

Final Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
1009.750000	---	28.10	54.00	25.90	15000.0	1000.000	V	27.0	-3.0
1009.750000	44.78	---	74.00	29.22	15000.0	1000.000	V	27.0	-3.0
1176.000000	42.11	---	74.00	31.89	15000.0	1000.000	H	128.0	-2.8
1176.000000	---	32.81	54.00	21.19	15000.0	1000.000	H	128.0	-2.8
1353.500000	---	28.94	54.00	25.06	15000.0	1000.000	H	168.0	-1.7
1353.500000	54.26	---	74.00	19.74	15000.0	1000.000	H	168.0	-1.7
1446.500000	---	24.22	54.00	29.78	15000.0	1000.000	V	185.0	-1.3
1446.500000	41.03	---	74.00	32.97	15000.0	1000.000	V	185.0	-1.3
1596.000000	41.63	---	74.00	32.37	15000.0	1000.000	H	150.0	-0.2
1596.000000	---	31.30	54.00	22.70	15000.0	1000.000	H	150.0	-0.2
1764.000000	---	30.86	54.00	23.14	15000.0	1000.000	V	253.0	0.3
1764.000000	42.20	---	74.00	31.80	15000.0	1000.000	V	253.0	0.3

1.3 Electromagnetic radiated emission (18 ... 40 GHz)



Annex B

Measurements results of EUT B

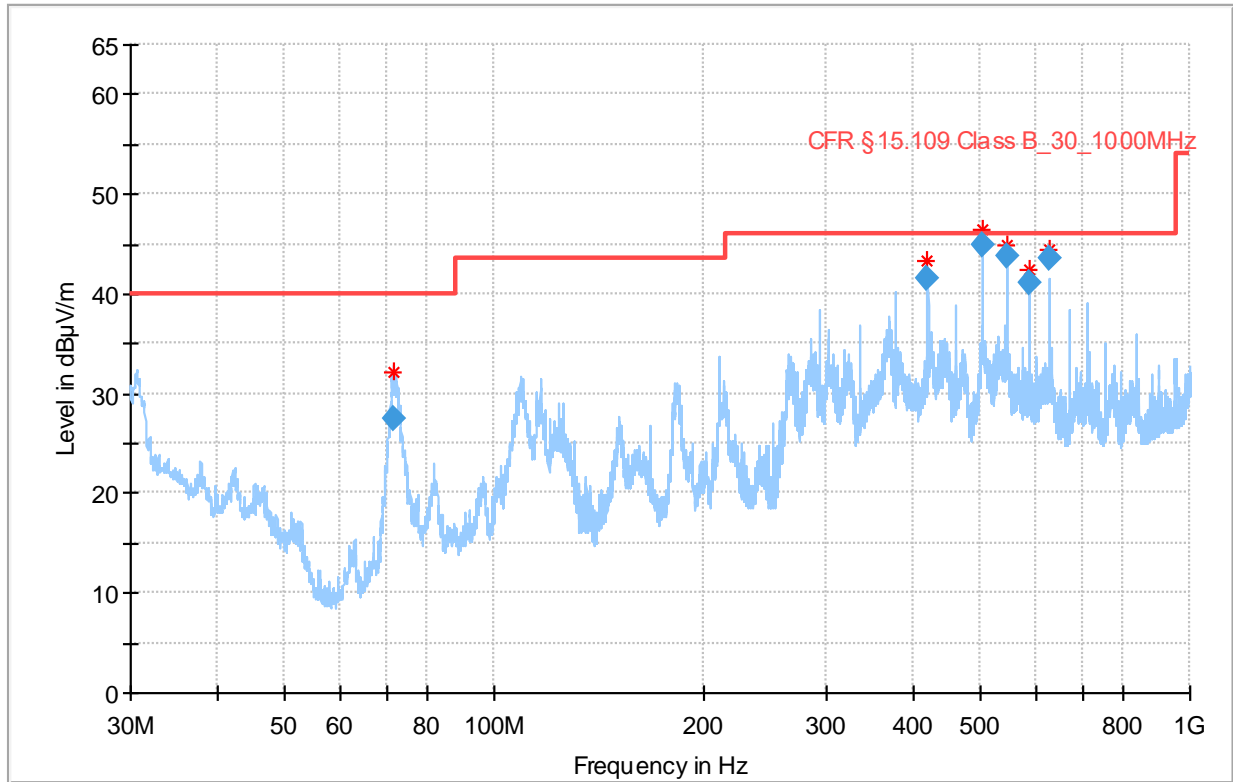
part of / in addition to

Test report no.: 21126659-24922-0

Date of issue: 2022-03-09

1.1 Electromagnetic radiated emission (30 ... 1000 MHz)

Full Spectrum

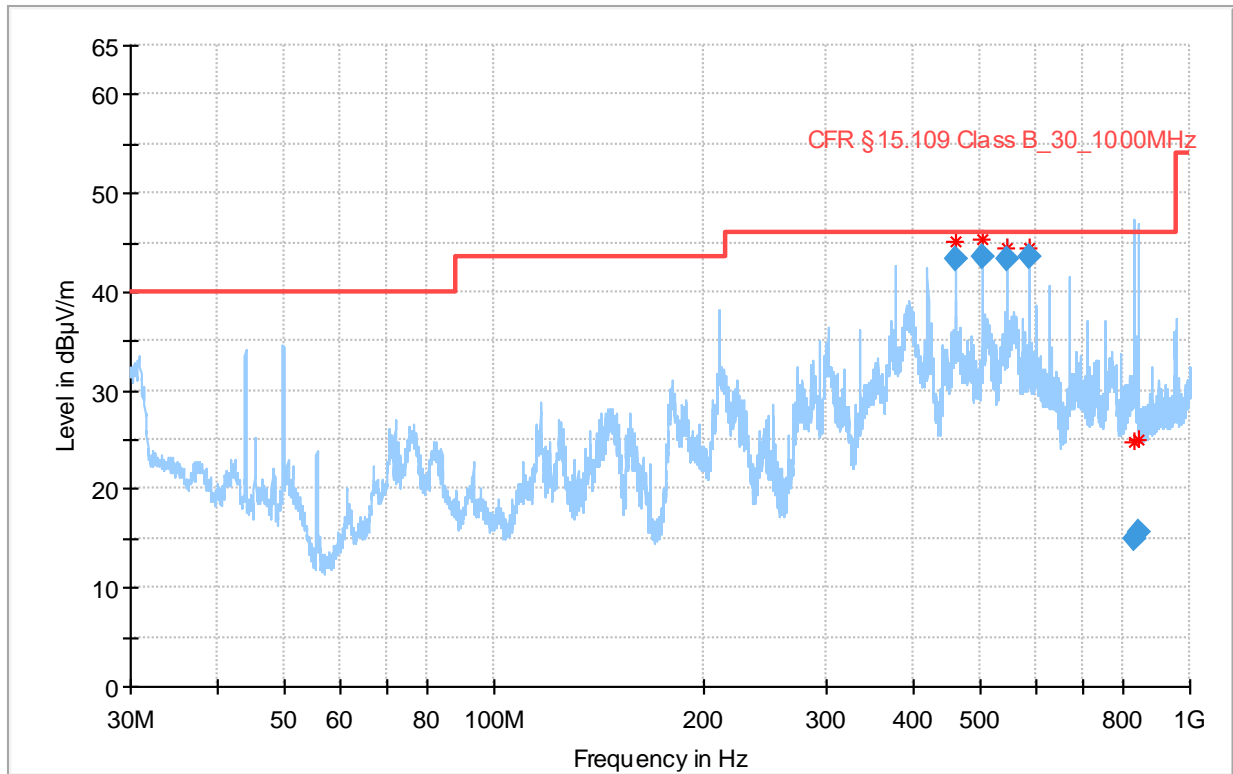


— Preview Result 1-PK+ * Critical_Freqs PK+
— CFR §15.109 Class B_30_1000MHz ◆ Final_Result QPK

Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
71.550000	27.51	40.00	12.49	15000.0	120.000	130.0	V	153.0	10.2
420.000000	41.45	46.00	4.55	15000.0	120.000	100.0	H	-2.0	17.0
504.000000	44.95	46.00	1.05	15000.0	120.000	124.0	V	3.0	18.9
546.000000	43.73	46.00	2.27	15000.0	120.000	103.0	V	37.0	19.3
588.000000	41.07	46.00	4.93	15000.0	120.000	103.0	V	10.0	20.2
630.000000	43.51	46.00	2.49	15000.0	120.000	130.0	H	86.0	20.6

Full Spectrum



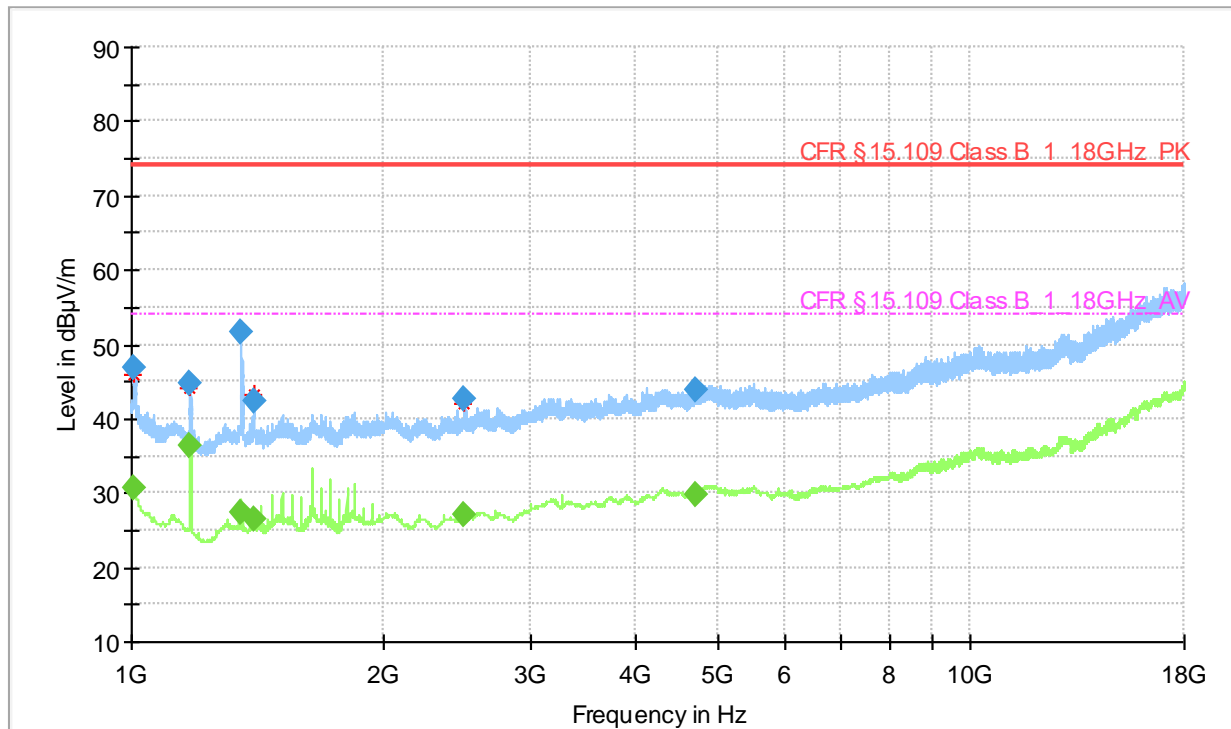
- Preview Result 1-PK+
- CFR §15.109 Class B_30_1000MHz
- * Critical_Freqs PK+
- ◆ Final_Result QPK

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
462.000000	43.22	46.00	2.78	15000.0	120.000	100.0	H	5.0	18.0
504.000000	43.56	46.00	2.44	15000.0	120.000	100.0	V	193.0	18.9
546.000000	43.26	46.00	2.74	15000.0	120.000	100.0	H	116.0	19.3
588.000000	43.56	46.00	2.44	15000.0	120.000	100.0	H	106.0	20.2
832.500000	15.02	46.00	30.98	15000.0	120.000	383.0	V	201.0	23.4
841.290000	15.54	46.00	30.46	15000.0	120.000	387.0	V	243.0	23.4

1.2 Electromagnetic radiated emission (1 ... 18 GHz)

Full Spectrum

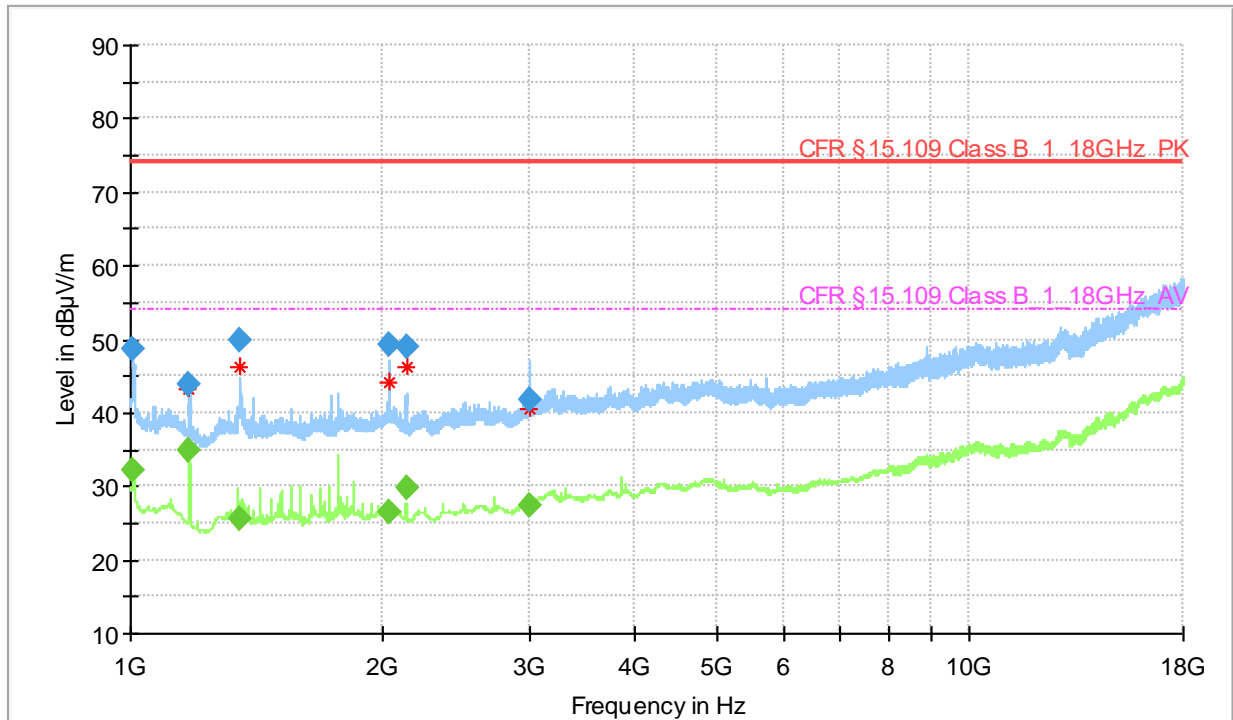


- Preview Result 2-AVG
- Preview Result 1-PK+
- * Critical_Freqs AVG
- * Critical_Freqs PK+
- CFR §15.109 Class B_1_18GHz_PK
- - - CFR §15.109 Class B_1_18GHz_AV
- ◆ Final_Result PK+
- ◆ Final_Result AVG

Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
1008.750000	---	30.76	54.00	23.24	15000.0	1000.000	V	212.0	-3.0
1008.750000	46.87	---	74.00	27.13	15000.0	1000.000	V	212.0	-3.0
1175.750000	---	36.46	54.00	17.54	15000.0	1000.000	H	187.0	-2.8
1175.750000	44.90	---	74.00	29.10	15000.0	1000.000	H	187.0	-2.8
1353.500000	---	27.26	54.00	26.74	15000.0	1000.000	V	182.0	-1.7
1353.500000	51.60	---	74.00	22.40	15000.0	1000.000	V	182.0	-1.7
1397.500000	---	26.37	54.00	27.63	15000.0	1000.000	H	168.0	-1.6
1397.500000	42.36	---	74.00	31.64	15000.0	1000.000	H	168.0	-1.6
2488.500000	---	26.95	54.00	27.05	15000.0	1000.000	H	288.0	3.6
2488.500000	42.58	---	74.00	31.42	15000.0	1000.000	H	288.0	3.6
4715.500000	---	29.79	54.00	24.21	15000.0	1000.000	V	3.0	10.0
4715.500000	43.82	---	74.00	30.18	15000.0	1000.000	V	3.0	10.0

Full Spectrum

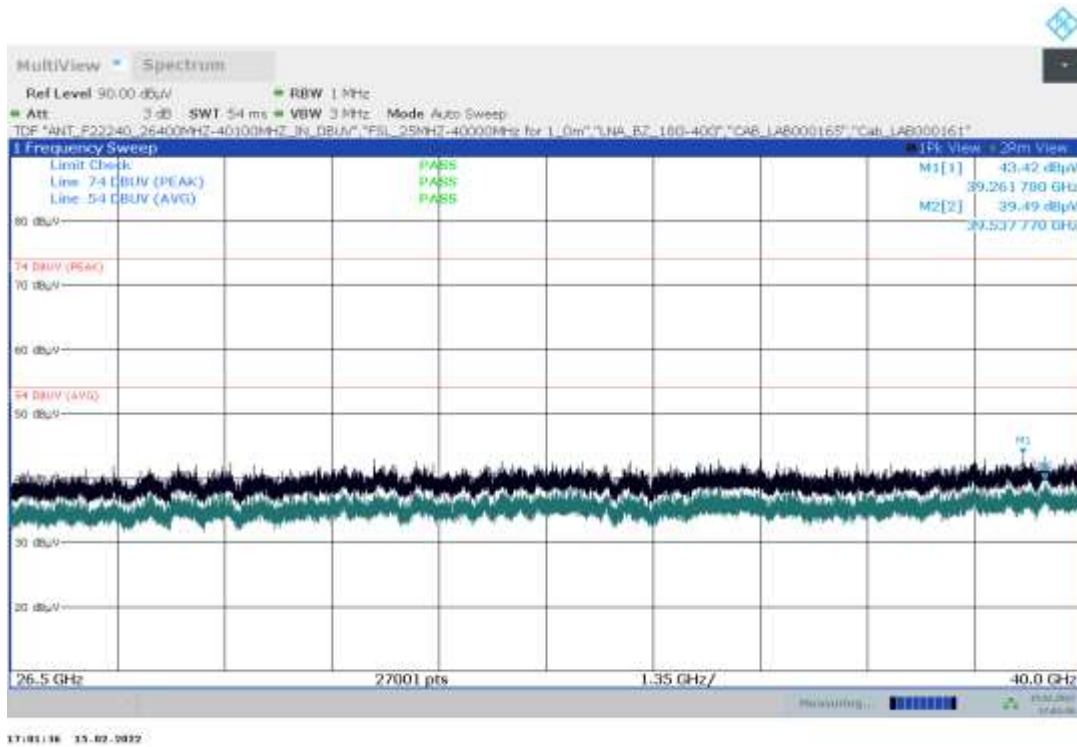
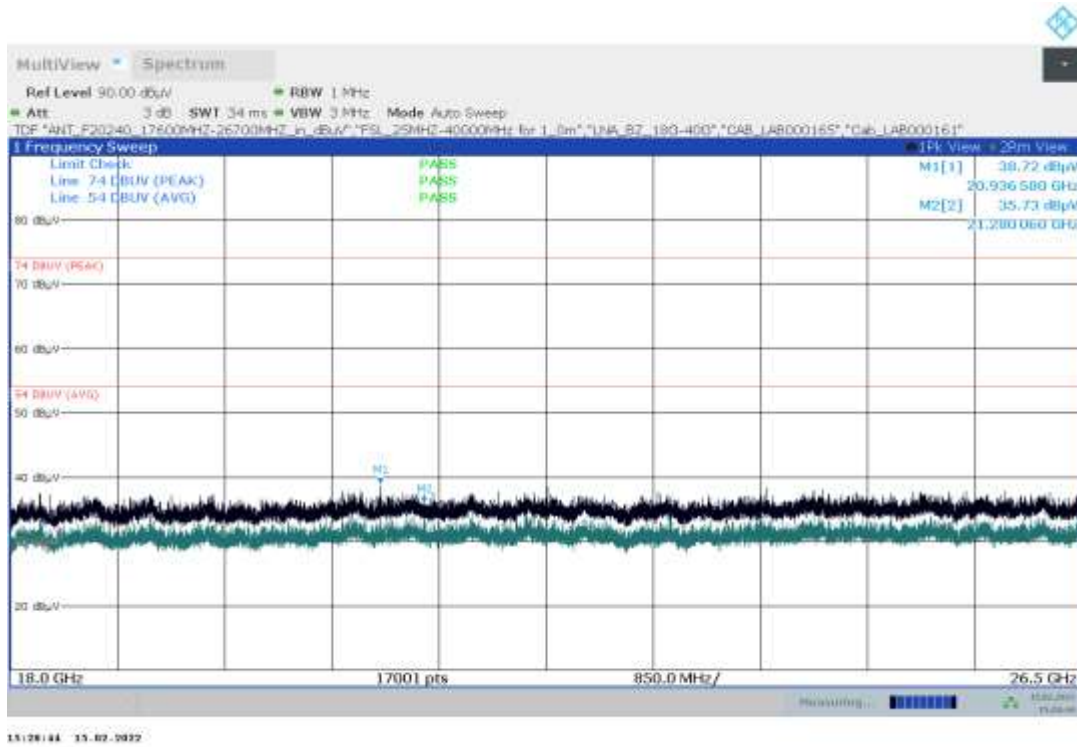


- Preview Result 2-AVG
- * Critical_Freqs AVG
- CFR §15.109 Class B_1_18GHz_PK
- ◆ Final_Result PK+
- Preview Result 1-PK+
- * Critical_Freqs PK+
- - - CFR §15.109 Class B_1_18GHz_AV
- ◆ Final_Result AVG

Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
1006.000000	48.74	---	74.00	25.26	15000.0	1000.000	V	192.0	-3.0
1006.000000	---	32.18	54.00	21.82	15000.0	1000.000	V	192.0	-3.0
1176.000000	43.77	---	74.00	30.23	15000.0	1000.000	H	116.0	-2.8
1176.000000	---	34.73	54.00	19.27	15000.0	1000.000	H	116.0	-2.8
1350.500000	---	25.48	54.00	28.52	15000.0	1000.000	V	160.0	-1.8
1350.500000	49.97	---	74.00	24.03	15000.0	1000.000	V	160.0	-1.8
2030.500000	49.24	---	74.00	24.76	15000.0	1000.000	H	187.0	2.5
2030.500000	---	26.55	54.00	27.45	15000.0	1000.000	H	187.0	2.5
2131.500000	48.89	---	74.00	25.11	15000.0	1000.000	V	57.0	2.1
2131.500000	---	29.71	54.00	24.29	15000.0	1000.000	V	57.0	2.1
2999.250000	---	27.35	54.00	26.65	15000.0	1000.000	V	276.0	5.5
2999.250000	41.76	---	74.00	32.24	15000.0	1000.000	V	276.0	5.5

1.1 Electromagnetic radiated emission (18 ... 40 GHz)



Annex C

Measurements results of EUT C

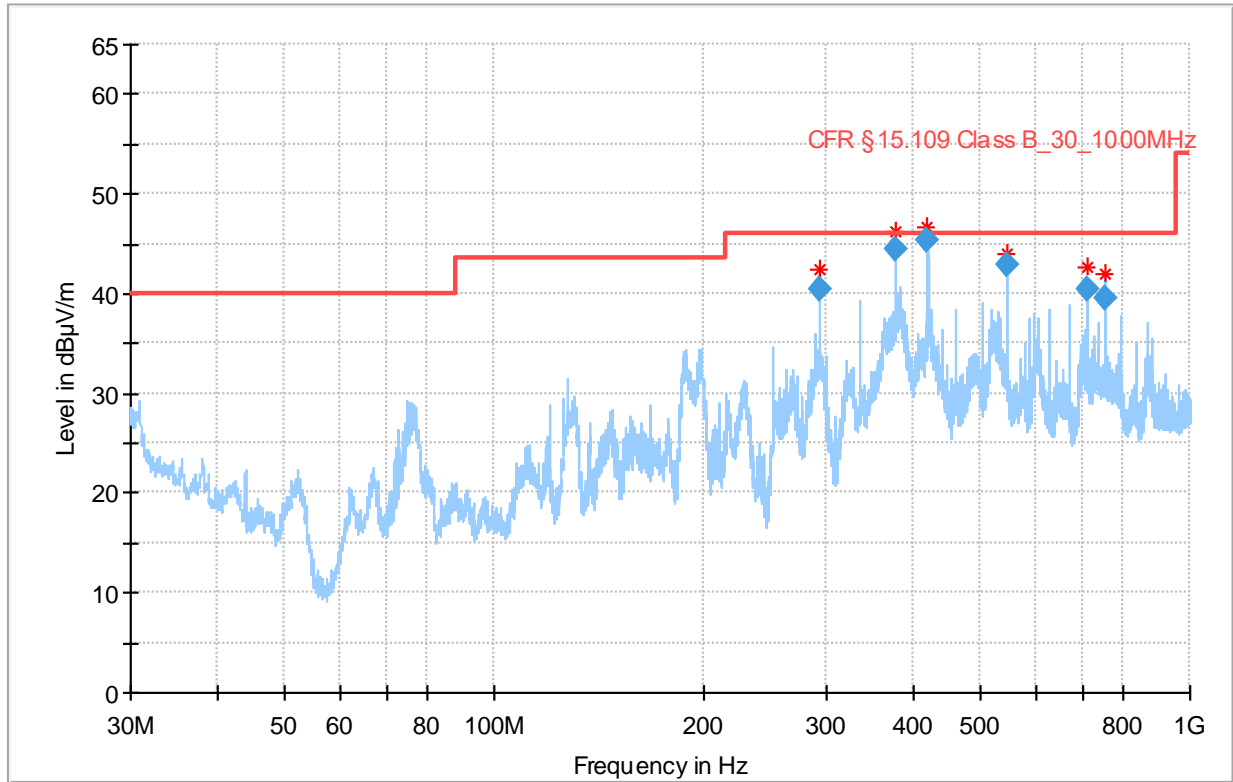
part of / in addition to

Test report no.: 21126659-24922-0

Date of issue: 2022-03-09

1.1 Electromagnetic radiated emission (30 ... 1000 MHz)

Full Spectrum

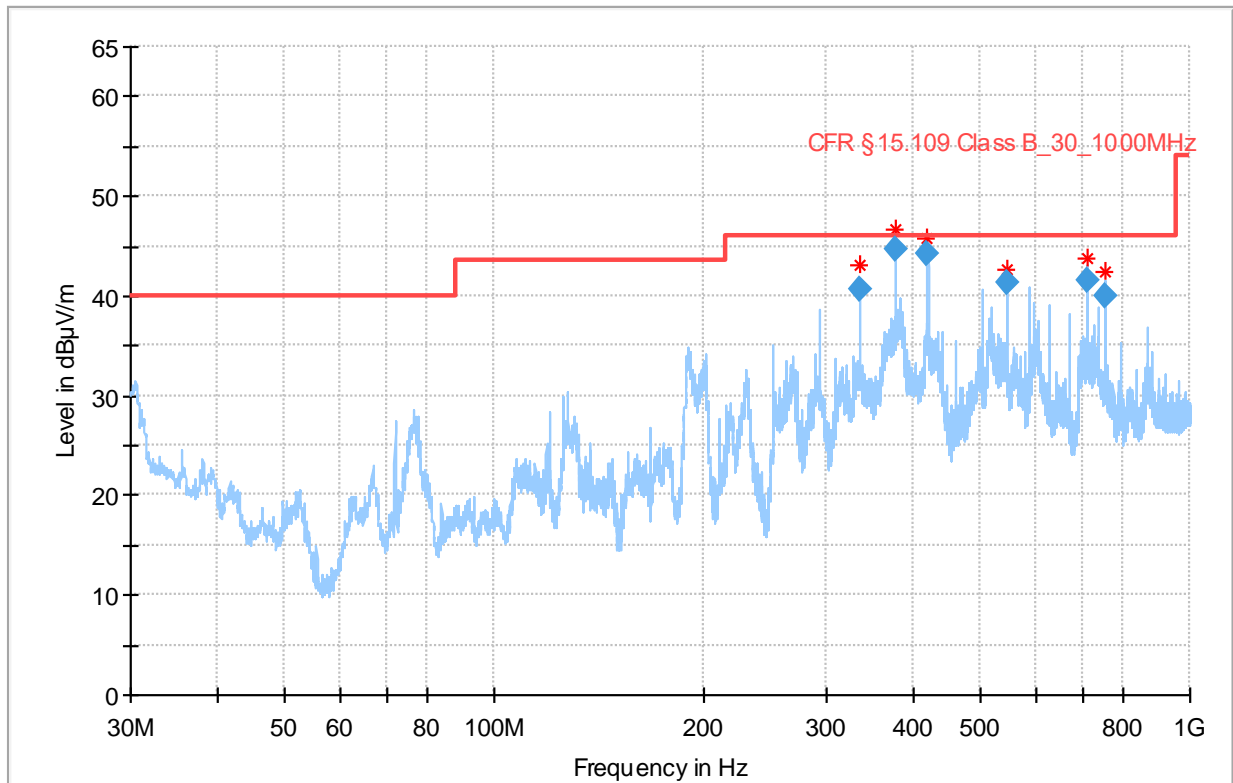


— Preview Result 1-PK+ * Critical_Freqs PK+
— CFR §15.109 Class B_30_1000MHz ◆ Final_Result QPK

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
294.000000	40.47	46.00	5.53	15000.0	120.000	100.0	V	72.0	13.7
378.000000	44.47	46.00	1.53	15000.0	120.000	103.0	H	273.0	15.9
420.000000	45.36	46.00	0.64	15000.0	120.000	111.0	H	44.0	17.0
546.000000	42.95	46.00	3.05	15000.0	120.000	130.0	H	-15.0	19.3
714.000000	40.52	46.00	5.48	15000.0	120.000	103.0	H	-38.0	21.8
756.000000	39.57	46.00	6.43	15000.0	120.000	104.0	H	35.0	22.3

Full Spectrum



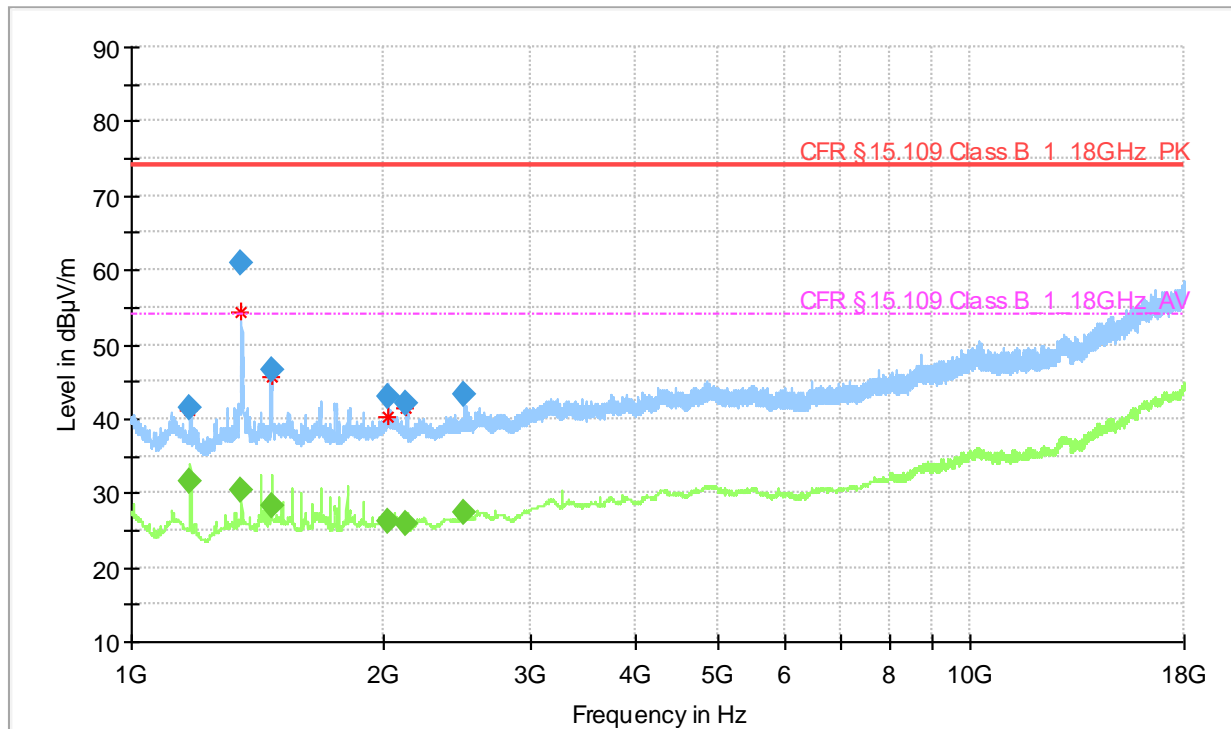
— Preview Result 1-PK+ * Critical_Freqs PK+
— CFR §15.109 Class B_30_1000MHz ◆ Final_Result QPK

Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
336.000000	40.75	46.00	5.25	15000.0	120.000	130.0	H	21.0	14.8
378.000000	44.68	46.00	1.32	15000.0	120.000	103.0	H	272.0	15.9
420.000000	44.23	46.00	1.77	15000.0	120.000	103.0	H	64.0	17.0
546.000000	41.32	46.00	4.68	15000.0	120.000	104.0	H	-19.0	19.3
714.000000	41.44	46.00	4.56	15000.0	120.000	103.0	H	-16.0	21.8
756.000000	39.99	46.00	6.01	15000.0	120.000	100.0	H	36.0	22.3

1.2 Electromagnetic radiated emission (1 ... 18 GHz)

Full Spectrum

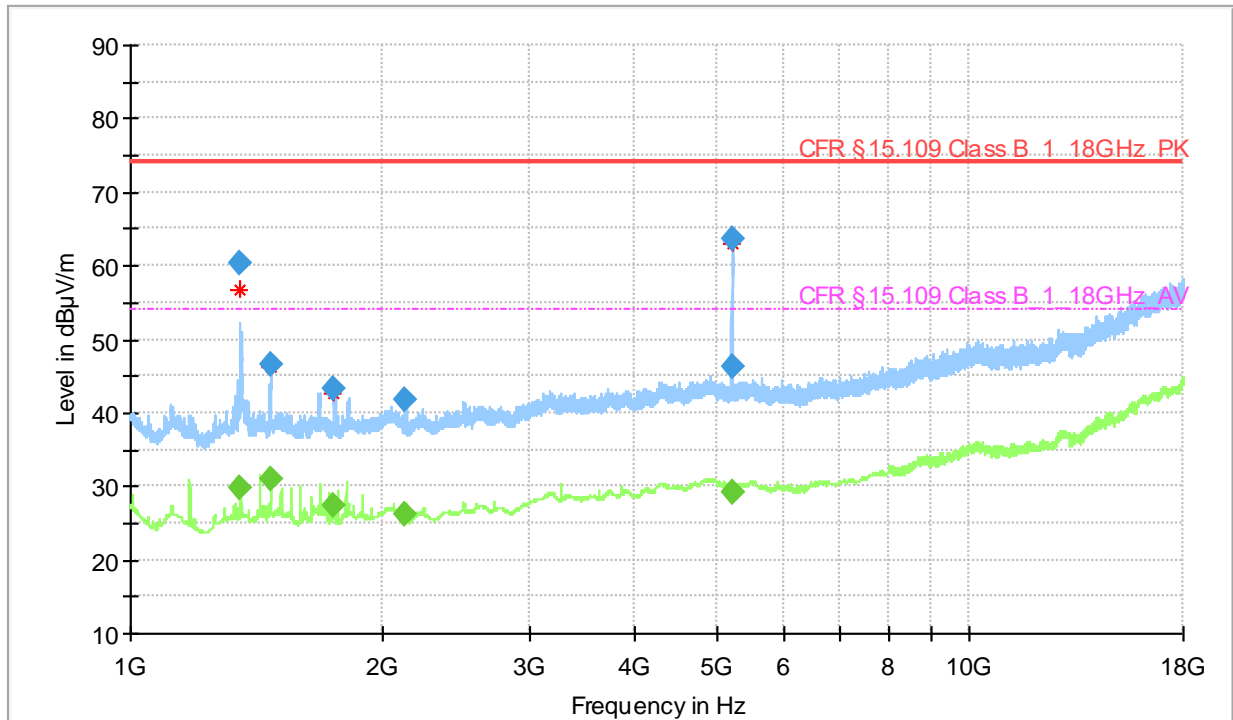


- Preview Result 2-AVG
- Preview Result 1-PK+
- * Critical_Freqs AVG
- * Critical_Freqs PK+
- CFR §15.109 Class B_1_18GHz_PK
- - - CFR §15.109 Class B_1_18GHz_AV
- ◆ Final_Result PK+
- ◆ Final_Result AVG

Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
1176.000000	---	31.66	54.00	22.34	15000.0	1000.000	V	198.0	-2.8
1176.000000	41.38	---	74.00	32.62	15000.0	1000.000	V	198.0	-2.8
1353.500000	60.93	---	74.00	13.07	15000.0	1000.000	V	260.0	-1.7
1353.500000	---	30.27	54.00	23.73	15000.0	1000.000	V	260.0	-1.7
1466.750000	---	28.37	54.00	25.63	15000.0	1000.000	V	249.0	-1.1
1466.750000	46.51	---	74.00	27.49	15000.0	1000.000	V	249.0	-1.1
2022.500000	42.83	---	74.00	31.17	15000.0	1000.000	V	113.0	2.5
2022.500000	---	26.26	54.00	27.74	15000.0	1000.000	V	113.0	2.5
2123.500000	42.12	---	74.00	31.88	15000.0	1000.000	V	62.0	2.1
2123.500000	---	26.01	54.00	27.99	15000.0	1000.000	V	62.0	2.1
2497.500000	43.40	---	74.00	30.60	15000.0	1000.000	H	178.0	3.7
2497.500000	---	27.52	54.00	26.48	15000.0	1000.000	H	178.0	3.7

Full Spectrum



- Preview Result 2-AVG
- Preview Result 1-PK+
- ◆ Critical_Freqs AVG
- ◆ Critical_Freqs PK+
- CFR §15.109 Class B_1_18GHz_PK
- - - CFR §15.109 Class B_1_18GHz_AV
- ◆ Final_Result PK+
- ◆ Final_Result AVG

Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
1353.500000	---	29.89	54.00	24.11	15000.0	1000.000	V	248.0	-1.7
1353.500000	60.41	---	74.00	13.59	15000.0	1000.000	V	248.0	-1.7
1470.250000	---	31.10	54.00	22.90	15000.0	1000.000	V	245.0	-1.0
1470.250000	46.61	---	74.00	27.39	15000.0	1000.000	V	245.0	-1.0
1747.250000	---	27.27	54.00	26.73	15000.0	1000.000	H	289.0	0.2
1747.250000	43.19	---	74.00	30.82	15000.0	1000.000	H	289.0	0.2
2124.750000	---	26.24	54.00	27.76	15000.0	1000.000	V	76.0	2.1
2124.750000	41.74	---	74.00	32.26	15000.0	1000.000	V	76.0	2.1
5210.000000	---	29.33	54.00	24.67	15000.0	1000.000	H	35.0	10.5
5210.000000	63.53	---	74.00	10.47	15000.0	1000.000	H	35.0	10.5
5221.000000	---	29.31	54.00	24.69	15000.0	1000.000	H	67.0	10.5
5221.000000	46.28	---	74.00	27.72	15000.0	1000.000	H	67.0	10.5

1.3 Electromagnetic radiated emission (18 ... 40 GHz)

