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United States of America

FCC LISTED, REGISTRATION NUMBER: 2764.01

ISED LISTED REGISTRATION NUMBER: 23595-1

Test report No:
3992ERM.003

Test report

FCC Rules and Regulations CFR 47, Part 15, Subpart B & C (2018) & ICES-003 ISSUE 7 – October (2020)

(*) Identification of item tested	Ultra Wideband (UWB) Impulse Radar Sensor
(*) Trademark	Novelda
(*) Model and /or type reference tested	X4F103
Other identification of the product	FCC ID: 2AD9Q-X4F103 IC: 22782-X4F103
(*) Features	-
Manufacturer	Novelda AS Garverivegen 2 Kviteseid 3850 Norway
Test method requested, standard	FCC Rules and Regulations CFR 47, Part 15, Subpart B & C (2018) ICES-003 ISSUE 7 – October (2020)
Summary	IN COMPLIANCE
Approved by (name / position & signature)	Domingo Galvez EMC&RF Lab Manager Digitally signed by Domingo Galvez DN: cn=Domingo Galvez, o=DEKRA Certification Inc., ou=Regulatory Lab, email=dgalvez@dekra.com, c=US
Date of issue	03-28-2023
Report template No	FDT08_23 (*) "Data provided by the client"

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Competences and guarantees

DEKRA Certification Inc. is a testing laboratory accredited by A2LA (The American Association for Laboratory Accreditation), to perform the tests indicated in the Certificate 2764.01

DEKRA Certification Inc. is a testing laboratory competent to carry out the tests described in this report.

In order to assure the traceability to other national and international laboratories, DEKRA Certification Inc. has a calibration and maintenance program for its measurement equipment.

DEKRA Certification Inc. guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at DEKRA Certification at the time of performance of the test.

DEKRA Certification Inc. is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

The results presented in this Test Report apply only to the particular item under test established in this document.

IMPORTANT: No parts of this report may be reproduced or quoted out of context, in any form or by any means, except in full, without the previous written permission of DEKRA Certification Inc.

General conditions

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of DEKRA Certification Inc.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of DEKRA Certification Inc. and the Accreditation Bodies.

Uncertainty

Uncertainty (factor k=2) was calculated according to the DEKRA Certification internal document PODT000.

	Frequency (MHz)	U (k=2)	Units
Radiated emission	30 - 1000	5.94	dB
	1000-18000	5.89	dB
Conducted emission	0,009 - 30	3.54	dB

Data provided by the client

The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item tested", "Trademark", "Model and/or type reference tested").

2. The sample consists of The X4F103 is an Ultra-Wideband (UWB) short-range impulse radar sensor module, designed for unlicensed operation in world-wide markets. The X4F103 contains all required circuitry, such as antennas, clocks and decoupling capacitors and can be connected directly to existing systems through a standard I2C or SPI interface.

3. The X4F103 sensor is extremely sensitive and can detect human presence based on respiration motion alone. The sensor accurately detects presence within the detection zone and has configurable range limits and sensitivity settings

DEKRA declines any responsibility with respect to the information provided by the client and that may affect the validity of results.

Usage of samples

Samples used for testing have been selected by **The Client.**
Sample S/01 is composed of the following elements:

Id	Control Number	Description	Manufacturer / Model	Serial Nº	Date of Reception	Application
S/01	3992/04	X4F103 Module with: - Adapter Board (XTT007) - DUT Stand - FPC XTCBLP012 (flex cable) - Controller board (XTMCU06)	Novelda / X4F103	-	2022-05-24	Element Under Test
S/01	3992/05	Emblobot (Moving target)		-	2022-05-24	Accessory
S/01	Dekra	AC Adapter	Ktec / KSA01A5210100D5	-	-	Auxiliary
S/01	Dekra	USB type A(male) to USB-C (male) cable	-	-	-	Auxiliary

1. Sample S/01, was used for the following test(s): All tests indicated in appendix A.

Test sample description

Test Sample description (compulsory information for EMC and RF testing services).

Ports…… :	Port name and description	Cable			
		Specified length [m]	Attached during test	Shielded	Coupled to patient
	No Data Provided		☐	☐	☐
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐
Supplementary information to the ports…… :	No Data Provided				

Rated power supply .....:	Voltage and Frequency		Reference poles			
			L1	L2	L3	N	PE
	☐	AC:	☐	☐	☐	☐	☐
	☐	AC:	☐	☐	☐	☐	☐
	☒	DC: 1.8 V - 3.3 V, Nominal 2.5 V					
	☐	DC:					

Rated Power .....:	No Data Provided
Clock frequencies.....:	No Data Provided
Other parameters .....:	No Data Provided
Software version .....:	0.3.1
Hardware version .....:	1.4
Dimensions in cm (W x H x D) ....:	No Data Provided

Mounting position .....:	☐	Table top equipment
	☐	Wall/Ceiling mounted equipment
	☐	Floor standing equipment
	☐	Hand-held equipment
	☒	Other:

Modules/parts.....:	Module/parts of test item	Type	Manufacturer
	No Data Provided		

Accessories (not part of the test item) .....:	Description	Type	Manufacturer
	No Data Provided		
Documents as provided by the applicant.....:	Description	File name	Issue date
	Declaration Equipment Data	FDT30_18 Declaration Equipment Data (1).pdf	1/17/2023
Copy of marking plate:			
NO MARKING PLATE FOUND			

Identification of the client

Novelda AS
Garverivegen 2
Kviteseid 3850
Norway

Testing period and place

Test Location	DEKRA Certification Inc.
Date (start)	02-27-2023
Date (finish)	02-27-2023

Document history

Report number	Date	Description
3992ERM.003	03-28-2023	First release

Environmental conditions

In the control chamber, the following limits were not exceeded during the test:

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 30 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

In the semi-anechoic chamber, the following limits were not exceeded during the test.

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 30 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

In the chamber for conducted measurements, the following limits were not exceeded during the test:

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 30 % Max. = 60 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

Remarks and comments

1. The tests have been performed by the technical personnel: Koji Nishimoto, Qi Zhang, and Victor Albrecht.

Testing verdicts

Not applicable :	N/A
Pass :	P
Fail :	F
Not measured :	N/M

Summary

Emission Test			
Report Section	**Requirement – Test case**	**Verdict**	**Remark**
A.1	Radiated Emission Electromagnetic Field – Unintentional Radiators (30 MHz – 1000 MHz)	P	N/A
A.1	Radiated Emission Electromagnetic Field – Unintentional Radiators (1 GHz – 18 GHz)	P	N/A
A.1	Radiated Emission Electromagnetic Field – Unintentional Radiators (18 GHz – 40 GHz)	P	N/A
A.2	Continuous Conducted Emission on Power Leads - Unintentional Radiators (150 kHz to 30 MHz)	P	Refer 1
A.3	Continuous Conducted Emission on Power Leads - Intentional Radiators (150 kHz to 30 MHz)	P	Refer 1
Supplementary information and remarks: 1) Conducted Emission test was performed using a Dekra AC Adapter.			

List of equipment used during the test

Radiated Emission Equipment

Control Number	Description	Manufacturer	Model	Last Calibration	Next Calibration
1012	ESR26 EMI Test Receiver	Rohde & Schwarz	ESR26	2022/04	2024/02
1014	FSV40 Signal Analyzer	Rohde & Schwarz	FSV40	2021/05	2023/05
1055	Double-Ridged Waveguide Horn Antennas	ETS Lindgren	3116C	2023/02	2026/02
1057	Double-ridge Waveguide Horn antenna	ETS Lindgren	3115	2020/06	2023/06
1064	Biconical log Antenna	ETS Lindgren	3142E	2021/12	2024/12
1108	Ethernet SNMP Thermometer- CR Room	HW Group	HWg-STE Plain	2022/10	2024/10
1111	Ethernet SNMP Thermometer- SAC	HW Group	HWg-STE Plain	2022/10	2024/10
1179	Semi-Anechoic Chamber	Frankonia	SAC 3plus 'L'	N/A	N/A
1217	Frankonia Transparent Test Table 1	Frankonia	FFT-Square	N/A	N/A
1314	Wireless measurement software EMC 32	Rohde & Schwarz	-	N/A	N/A
1462	Low Noise Preamplifier (1-18GHz)	Bonn Elektronik	BLMA1840-4G	2022/06	2024/06

Appendix A: Test results

Appendix A Content

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DESCRIPTION OF THE OPERATION MODES

The operation modes described in this paragraph represent functionalities of the sample under test.

The following operation modes of the samples were used during the test executions:

OPERATION MODE	DESCRIPTION
OM/01(*)	DUT ON. Powered by 2.5 Vdc by AC adapter. • UWB in Idle mode.
OM/02	DUT ON. Powered by 2.5 Vdc by AC adapter. • UWB in Tx mode.

*Worst configuration detected

A.1. RADIATED EMISSION ELECTROMAGNETIC FIELD – UNINTENTIONAL RADIATORS

LIMITS:	Product standard:	FCC CFR 47, Part 15, Subpart B (2018), Secs. 15.109 & ICES-003 Issue 7 – October (2021)
	Test standard:	FCC CFR 47, Part 15, Subpart B (2018), Secs. 15.109 & ICES-003 Issue 7 – October (2020); ANSI C63.4 (2014)

Limits of interference Class B
The applied limit for radiated emissions, 3 m distance, in the frequency range 30 MHz to 40 GHz for class B equipment, according with the requirements of:

FCC Rules and Regulations 47 CFR Part 15, Subpart B, Secs. 15.109 (a).
[54 FR 17714, Apr. 25, 1989, as amended at 56 FR 373, Jan. 4, 1991; 58 FR 51249, Oct. 1, 1993; 66 FR 19098, Apr. 13, 2001; 67 FR 48993, July 29, 2002; 69 FR 2849, Jan. 21, 2004; 80 FR 33447, June 12, 2015]

Frequency range (MHz)	QP Limit for 3 m	
	(µV/m)	(dBµV/m)
30 to 88	100	40
88 to 216	150	43.5
216 to 960	200	46
Above 960	500	54

Frequency range (MHz)	AVG Limit for 3 m		PK Limit for 3 m (1)
	(µV/m)	(dBµV/m)	(dBµV/m)
Above 1000	500	54	74

(1) Frequencies above 1 GHz, the limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test, as per §15.35(b)

ICES-003 Issue 7, Secs 3.2.2, table 2 & 4 (October 2020).

Frequency range (MHz)	QP Limit for 3 m	
	(µV/m)	(dBµV/m)
30 to 88	100	40
88 to 216	150	43.5
216 to 230	200	46
230 to 960	224	47
Above 960	500	54

Frequency range (MHz)	AVG Limit for 3 m		PK Limit for 3 m (1)
	(µV/m)	(dBµV/m)	(dBµV/m)
Above 1000	500	54	74

TEST SETUP

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at a distance of 3 m for the frequency range 30-100 MHz (Bilog antenna) and 1-18 GHz (Double ridge horn antenna).

The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

Measurements were made in both horizontal and vertical planes of polarization.

The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

TEST SETUP (CONT.)	

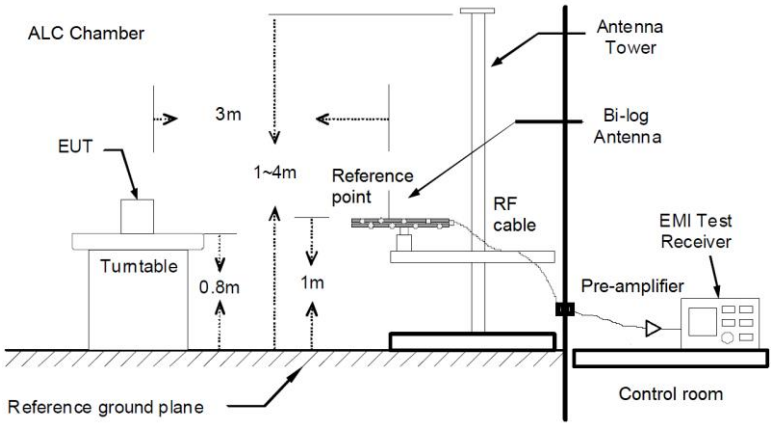


Fig A1: Generic setup for measurements from 30 to 1000MHz

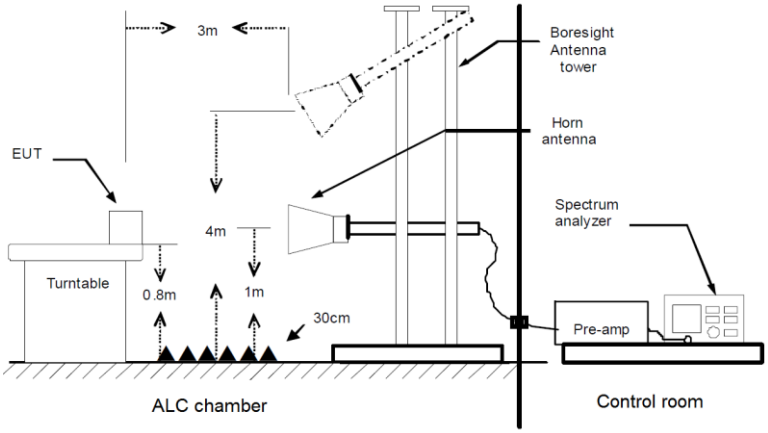
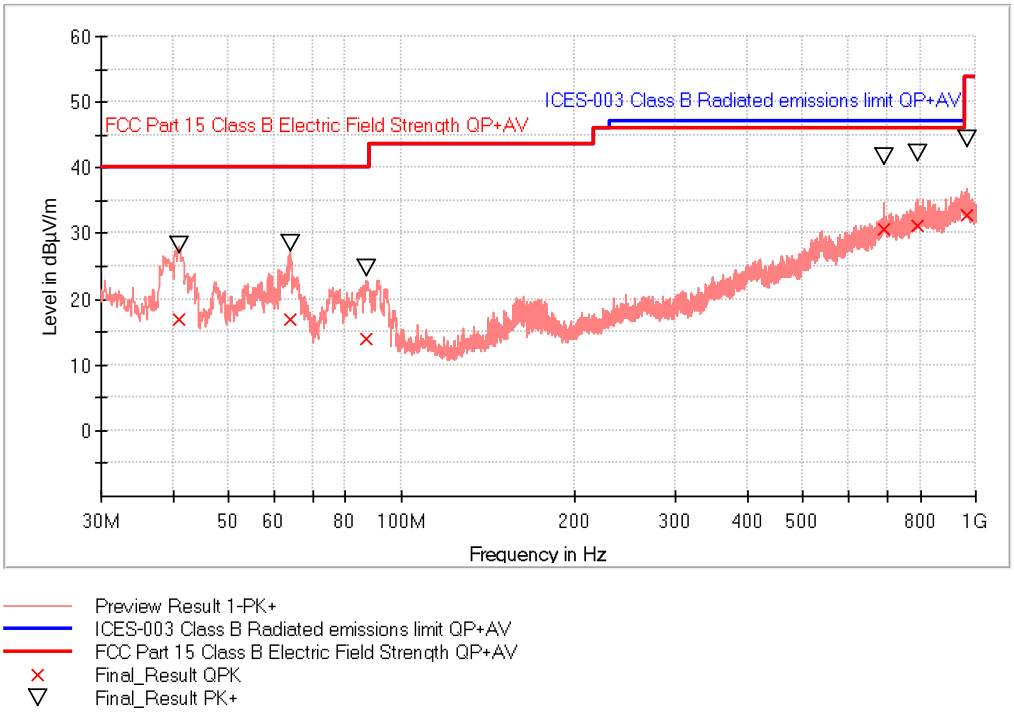


Fig A2: Generic setup for measurements from 1 to 18GHz

TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	OM/01
TEST RESULTS:	CRmmnnxx: CR: Radiation Condition, mm: Sample number, nn: Operation mode, xx: Frequency Range (LR: Low Range, HR1: High Range 1-18GHz, HR2: High Range 18-40GHz.)

CRmmnnxx	Description	Result
CR0101LR	Range: 30 MHz - 1000 MHz Horizontal and Vertical Polarization	P
CR0101HR1	Range: 1GHz - 18 GHz Horizontal and Vertical Polarization	P
CR0101HR2	Range: 18GHz - 40 GHz Horizontal and Vertical Polarization	P

TEST RESULTS (Cont.):	CR0101LR

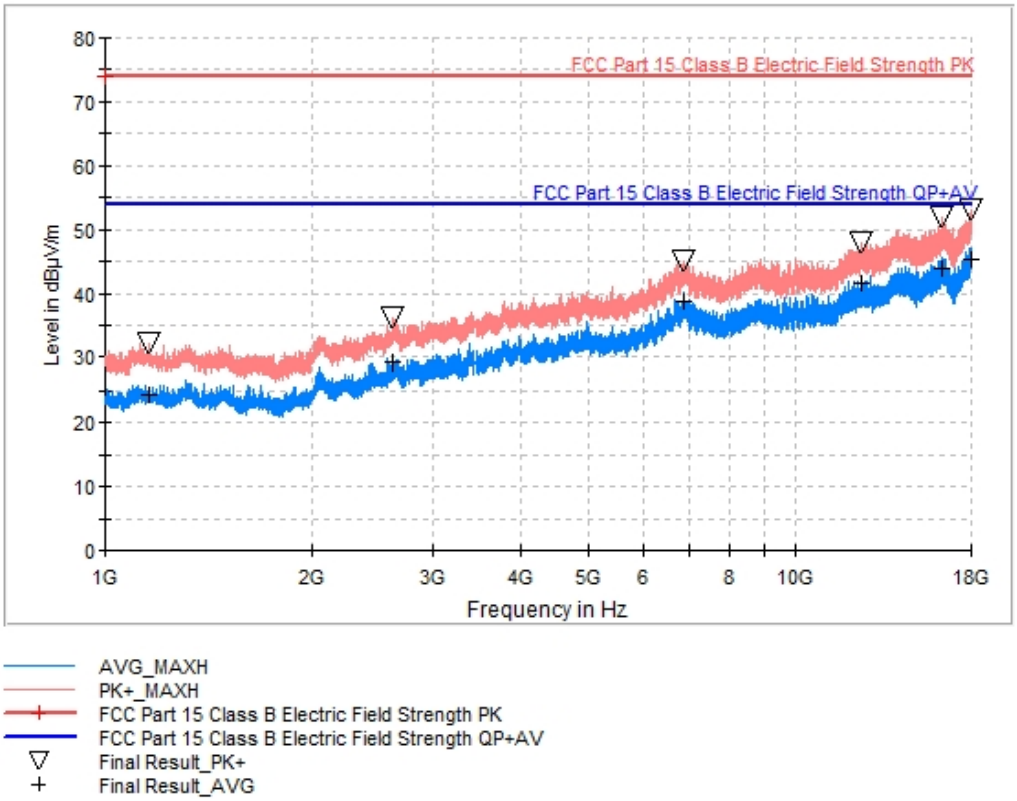


Frequency (MHz)	QuasiPeak (dBµV/m)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pol	Azimuth (deg)
40.863297	16.86	28.33	40.00	23.14	V	61.0
64.095762	16.86	28.52	40.00	23.14	V	-10.0
86.841644	13.84	24.62	40.00	26.16	V	-137.0
692.850146	30.78	41.75	46.00	15.22	V	140.0
793.827084	31.18	42.20	46.00	14.82	H	-84.0
967.213605	32.71	44.29	53.90	21.19	H	65.0

Spectrum Analyzer Parameters

Subrange	Step Size	Detectors	Bandwidth	Sweep Time
30 MHz - 1 GHz	48.5 kHz	PK+	100 kHz	1 s

TEST RESULTS (Cont.):	CR0101HR1

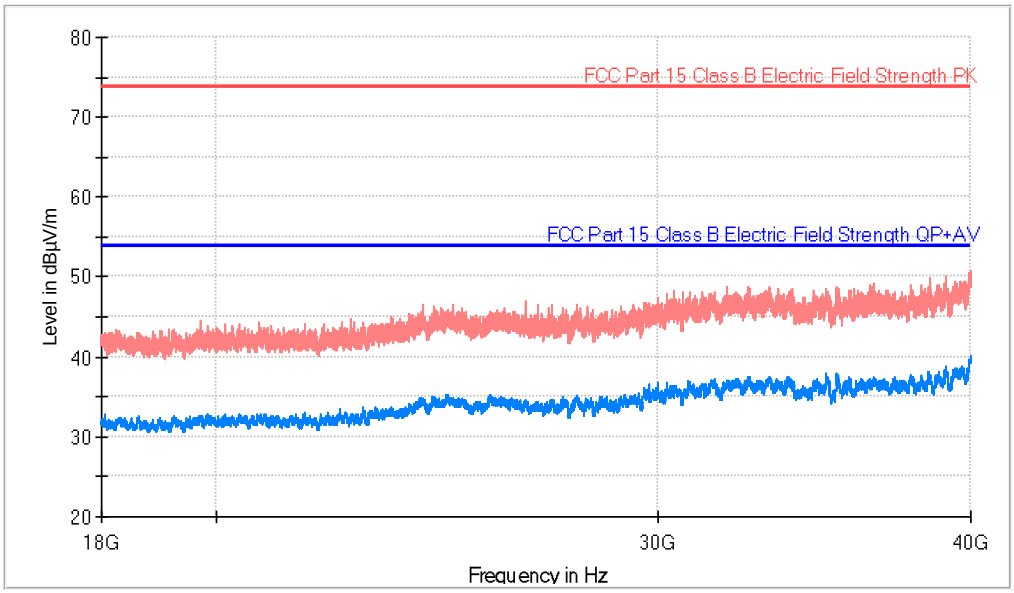


Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBµV/m)
1158.000000	32.1	24.2	V	29.7	53.9
2616.500000	36.1	29.3	V	24.6	53.9
6902.000000	45.1	38.6	H	15.3	53.9
12475.000000	48.0	41.7	V	12.2	53.9
16314.500000	52.0	43.9	V	10.0	53.9
17984.000000	53.0	45.2	V	8.7	53.9

Spectrum Analyzer Parameters

Subrange	Step Size	Detectors	Bandwidth	Sweep Time
1 GHz - 3 GHz	500 kHz	PK+ ; AVG	1 MHz	1 s
3 GHz - 18 GHz	500 kHz	PK+ ; AVG	1 MHz	1 s

TEST RESULTS (Cont.):	CR0101HR2



AVG_MAXH
PK+_MAXH
FCC Part 15 Class B Electric Field Strength PK
FCC Part 15 Class B Electric Field Strength QP+AV

Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBµV/m)
39994.500000	50.1	40.1	V	13.8	53.9

Spectrum Analyzer Parameters

Subrange	Step Size	Detectors	Bandwidth	Sweep Time
18 GHz - 40 GHz	1.1 MHz	PK+ ; AVG	1 MHz	1 s

A.2. CONTINUOUS CONDUCTED EMISSION ON POWER LEADS - UNINTENTIONAL RADIATORS

LIMITS:	Product standard:	FCC CFR 47, Part 15, Subpart B (2018), Secs. 15.107 & ICES-003 Issue 7 – Update October (2021)
	Test standard:	FCC CFR 47, Part 15, Subpart B (2018), Secs. 15.107 & ICES-003 Issue 7 – Update October (2021); ANSI C63.4 (2014)

The applied limit for continuous conducted emissions in power leads, according with the requirements of FCC Rules and Regulations 47 CFR Part 15, Subpart B (2018), Secs. 15.107 & ICES Issue 7 (2020), in the frequency range 0,15 to 30 MHz, for Class B equipment was:

FCC Rules and Regulations 47 CFR Part 15, Subpart B, Secs. 15.107 (a).
[54 FR 17714, Apr. 25, 1989, as amended at 57 FR 33448, July 29, 1992; 58 FR 51249, Oct. 1, 1993; 66 FR 19098, Apr. 13, 2001; 67 FR 45670, July 10, 2002]

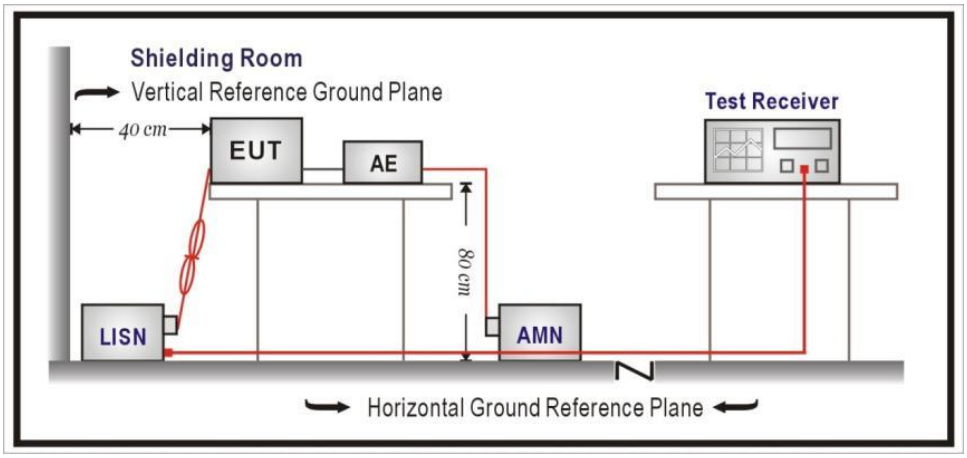
Frequency range (MHz)	Limit	
	Quasi-peak [dB(µV)[1)]]	Average [dB(µV)[1)]]
0,15 to 0,5	66-56 [2)]	56-46[2)]
0,5 to 5	56	46
5 to 30	60	50

[1)] At the transition frequency, the lower limit applies.
[2)] The limit decreases linearly with the logarithm of the frequency.

TEST SETUP	

The EUT is placed on the test table, raised 80 cm above the reference ground plane. The vertical conducting plane is located 40 cm to the rest of the EUT.

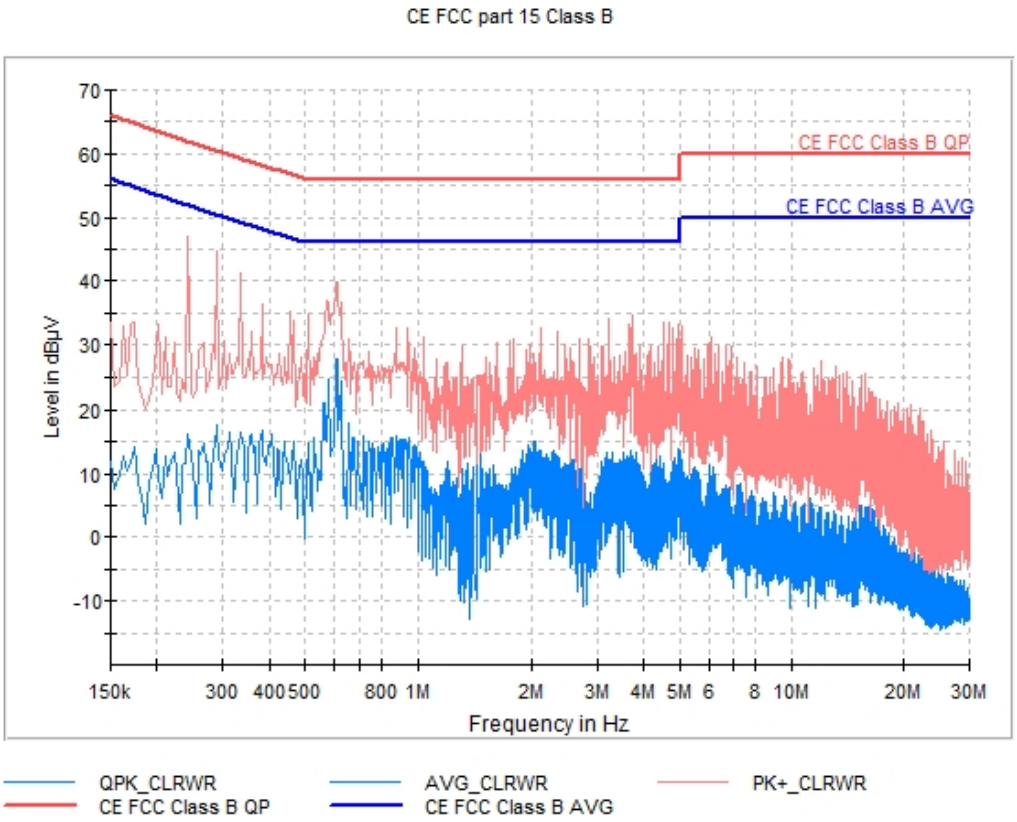
The EUT is connected to line impedance stabilization network (LISN) and other accessories are connected to other LISN. Measured levels of AC power line conducted emission are across the 50 ohms LISN port.



TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	OM/01
TEST RESULTS:	CCmmnnhh: CC: Conducted Condition, mm: Sample number, nn: Test condition mode, hh: wire

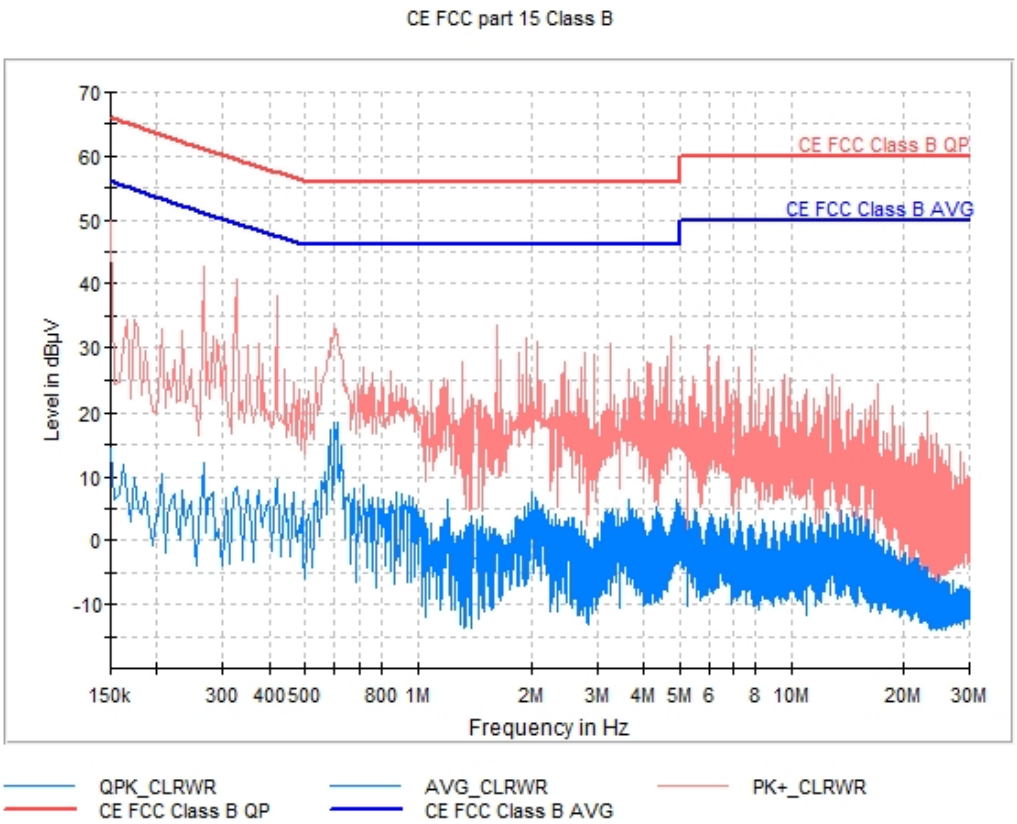
CRmmnnhh	DESCRIPTION	RESULT
CC0101L1	Phase wire noise.	P
CC0101N	Neutral wire noise.	P

TEST RESULTS (Cont.):	CC0101L1



Frequency (MHz)	PK+_CLRWR (dBµV)	AVG_CLRWR (dBµV)	Line	Margin - AVG (dB)	Limit - AVG (dBµV)
0.242000	47.1	16.3	L1	35.5	51.8
0.382000	36.2	16.8	L1	31.3	48.1
0.606000	39.9	27.8	L1	18.2	46.0
0.878000	32.8	16.1	L1	29.9	46.0
2.034000	28.7	15.2	L1	30.8	46.0
2.126000	32.7	13.6	L1	32.4	46.0
4.934000	29.8	13.9	L1	32.1	46.0
6.206000	28.5	9.9	L1	40.1	50.0
11.266000	17.8	6.2	L1	43.8	50.0
17.782000	19.7	1.2	L1	48.8	50.0

TEST RESULTS (Cont.):	CC0101N



Frequency (MHz)	PK+_CLRWR (dBµV)	AVG_CLRWR (dBµV)	Line	Margin - AVG (dB)	Limit - AVG (dBµV)
0.150000	49.8	14.5	N	41.5	56.0
0.418000	38.1	9.5	N	37.9	47.4
0.598000	32.9	18.6	N	27.4	46.0
0.878000	20.9	7.7	N	38.3	46.0
2.006000	23.7	7.6	N	38.4	46.0
2.150000	19.0	5.7	N	40.3	46.0
4.894000	21.9	6.5	N	39.5	46.0
7.214000	18.8	4.5	N	45.5	50.0
13.642000	15.0	4.7	N	45.3	50.0
18.178000	13.7	-0.3	N	50.3	50.0

Spectrum Analyzer Parameters

Subrange	Step Size	Detectors	IF BW	Meas. Time	Preamp
150 kHz - 30	4 kHz	PK+ ; AVG	9 kHz	0.01 s	0 dB

A.3. CONTINUOUS CONDUCTED EMISSION ON POWER LEADS - INTENTIONAL RADIATORS

LIMITS:	Product standard:	FCC CFR 47, Part 15, Subpart C (2018), Secs. 15.207 & ICES-003 Issue 7 – Update October (2021)
	Test standard:	FCC CFR 47, Part 15, Subpart C (2018), Secs. 15.207 & ICES-003 Issue 7 – Update October (2021); ANSI C63.4 (2014)

The applied limit for continuous conducted emissions in power leads, according with the requirements of FCC Rules and Regulations 47 CFR Part 15, Subpart C (2018), Secs. 15.207 & ICES Issue 7 (2020), in the frequency range 0,15 to 30 MHz, for Class B equipment was:

FCC Rules and Regulations 47 CFR Part 15, Subpart C, Secs. 15.207 (a).
[54 FR 17714, Apr. 25, 1989, as amended at 56 FR 373, Jan. 4, 1991; 57 FR 33448, July 29, 1992; 58 FR 51249, Oct. 1, 1993; 67 FR 45671, July 10, 2002]

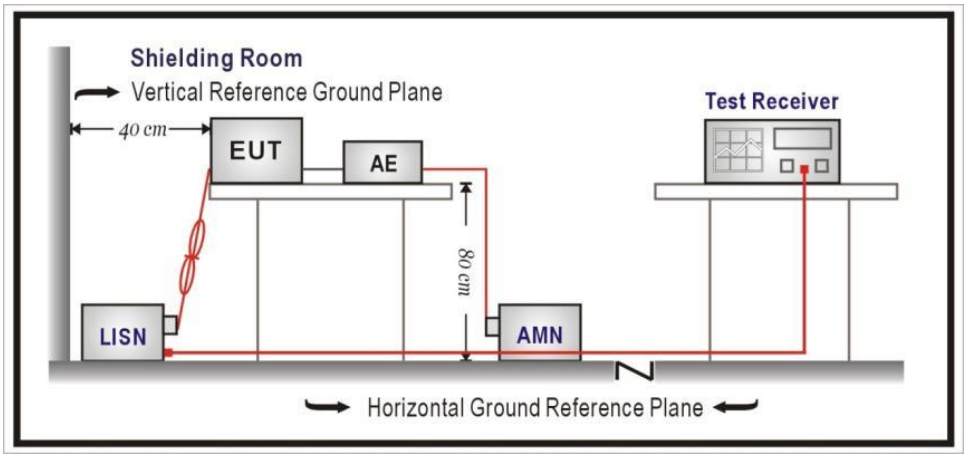
Frequency range (MHz)	Limit	
	Quasi-peak [dB(µV)[1)]]	Average [dB(µV)[1)]]
0,15 to 0,5	66-56 [2)]	56-46[2)]
0,5 to 5	56	46
5 to 30	60	50

[1)] At the transition frequency, the lower limit applies.
[2)] The limit decreases linearly with the logarithm of the frequency.

TEST SETUP	

The EUT is placed on the test table, raised 80 cm above the reference ground plane. The vertical conducting plane is located 40 cm to the rest of the EUT.

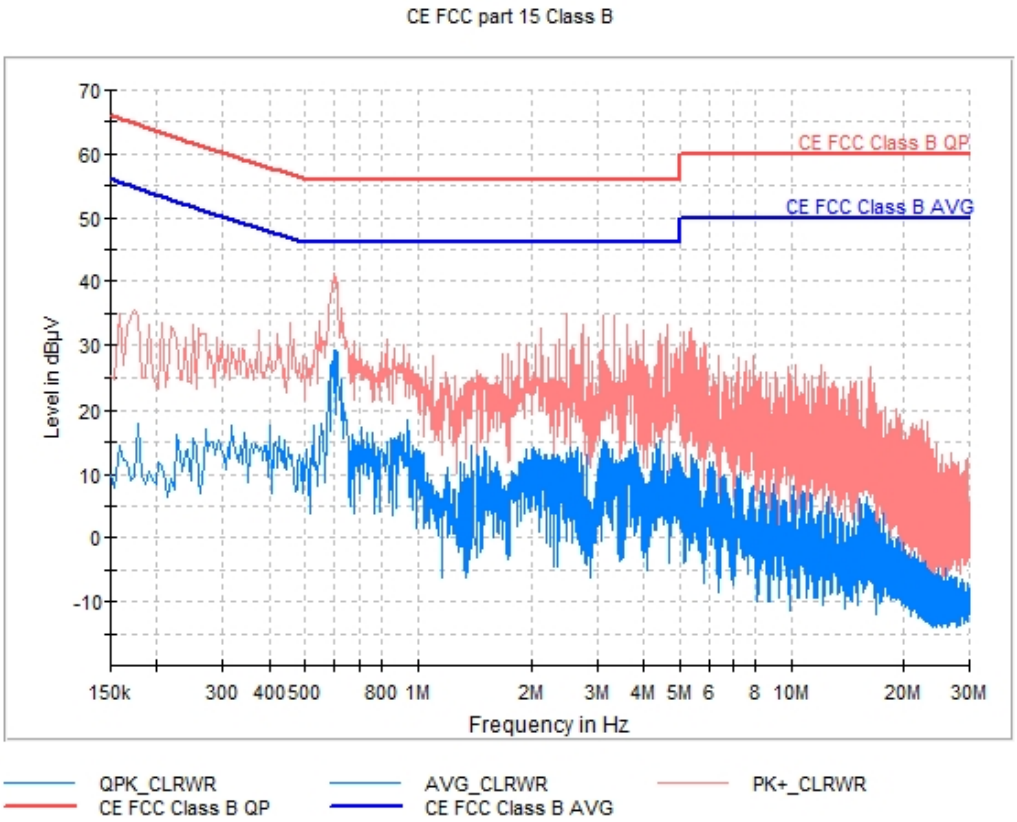
The EUT is connected to line impedance stabilization network (LISN) and other accessories are connected to other LISN. Measured levels of AC power line conducted emission are across the 50 ohms LISN port.



TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	OM/02
TEST RESULTS:	CCmmnnhh: CC: Conducted Condition, mm: Sample number, nn: Test condition mode, hh: wire

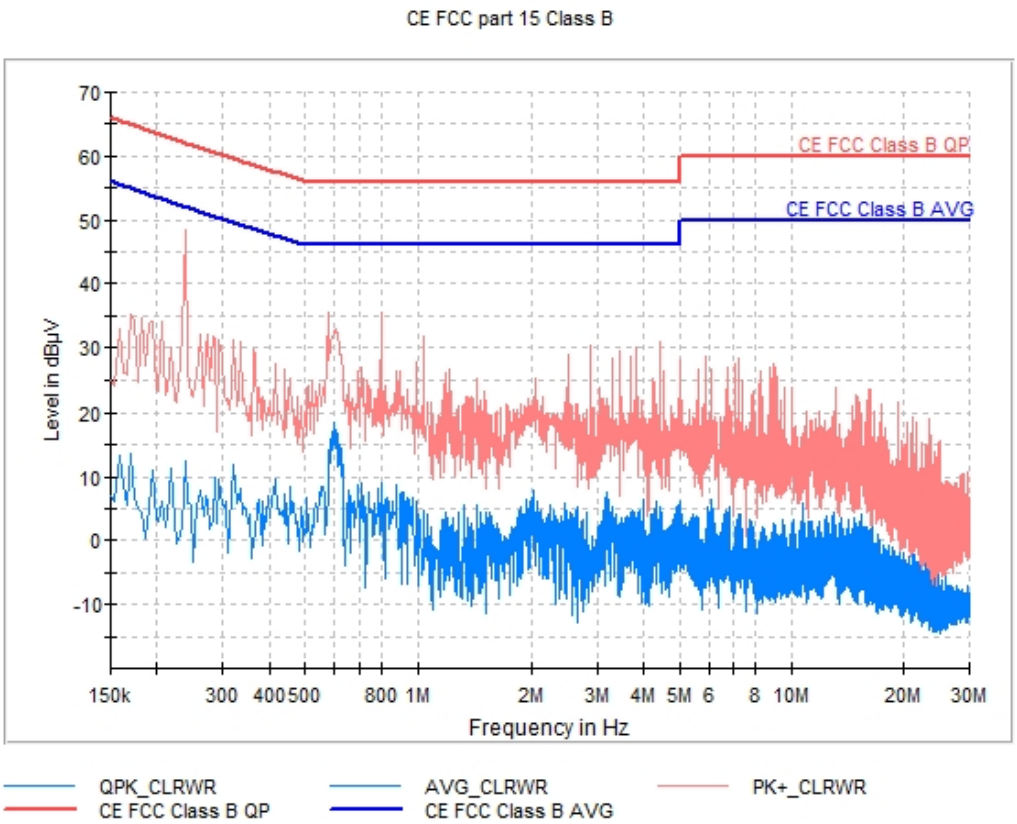
CRmmnnhh	DESCRIPTION	RESULT
CC0102L1	Phase wire noise.	P
CC0102N	Neutral wire noise.	P

TEST RESULTS (Cont.):	CC0102L1



Frequency (MHz)	PK+_CLRWR (dBµV)	AVG_CLRWR (dBµV)	Line	Margin - AVG (dB)	Limit - AVG (dBµV)
0.250000	33.3	15.8	L1	35.8	51.5
0.402000	29.7	17.5	L1	30.1	47.7
0.598000	39.8	29.3	L1	16.7	46.0
0.942000	26.6	18.4	L1	27.6	46.0
1.402000	24.7	14.5	L1	31.5	46.0
2.534000	29.2	15.4	L1	30.6	46.0
3.758000	25.1	15.8	L1	30.2	46.0
6.126000	21.9	11.9	L1	38.1	50.0
10.722000	17.1	7.4	L1	42.6	50.0
18.254000	12.6	1.7	L1	48.3	50.0

TEST RESULTS (Cont.):	CC0102N



Frequency (MHz)	PK+_CLRWR (dBµV)	AVG_CLRWR (dBµV)	Line	Margin - AVG (dB)	Limit - AVG (dBµV)
0.238000	48.4	12.4	N	39.5	51.9
0.322000	31.2	11.9	N	37.5	49.4
0.594000	31.9	18.5	N	27.5	46.0
0.798000	35.4	9.2	N	36.8	46.0
2.030000	22.7	7.9	N	38.1	46.0
3.206000	19.5	7.5	N	38.5	46.0
4.006000	13.8	6.3	N	39.7	46.0
6.810000	13.2	5.3	N	44.7	50.0
10.698000	16.1	5.9	N	44.1	50.0
18.174000	14.3	-0.7	N	50.7	50.0

Spectrum Analyzer Parameters

Subrange	Step Size	Detectors	IF BW	Meas. Time	Preamp
150 kHz - 30	4 kHz	PK+ ; AVG	9 kHz	0.01 s	0 dB