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Test Report

Report Number:

F220997E2, 2nd version

Equipment under Test (EUT):

NEARFI P 2A B

Applicant:

PHOENIX CONTACT Electronics GmbH

Manufacturer:

PHOENIX CONTACT GmbH & Co.KG

ilac-MRA

DAkkS Deutsche Akkreditierungsstelle D-PL-17186-01-00

References

[1] FCC/OST MP-5 (1986) FCC methods of measurement of radio noise emissions from industrial, scientific and medical equipment.

[2] FCC 47 CFR Part 2 General Rules and Regulations

[3] FCC 47 CFR Part 18 INDUSTRIAL, SCIENTIFIC, AND MEDICAL EQUIPMENT

[4] RSS-216 Issue 2 (January 2016) Amendment 1 (September 2020) Wireless Power Transfer Devices

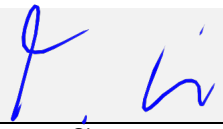
[5] RSS-Gen Issue 5 (March 2019) Amendment 1 General Requirements for Compliance of Radio Apparatus

[6] ICES-001 Issue 5 (July 2020) Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment

[7] CSA CISPR 11:19 Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement (IEC CISPR 11:2015+A1:2016, MOD)

Test Result

The requirements of the tests performed as shown in the overview (clause 4) were fulfilled by the equipment under test. The complete test results are presented in the following.
“Passed” indicates that the equipment under test conforms with the relevant limits of the testing standard without taking any measurement uncertainty into account. However, the measurement uncertainty is calculated and shown in this test report.

Tested by:	OBO		Thomas Kühn 22.11.2023
		Signature	
Written by:			Thomas Kühn 22.11.2023
		Signature	
Reviewed and approved by:			Bernd STEINER 22.11.2023
		Signature	

This test report is only valid in its original form.

The test results herein refer only to the tested sample. PHOENIX TESTLAB GmbH is not responsible for any generalisations or conclusions drawn from these test results concerning further samples. Any modification of the tested samples is prohibited and leads to the invalidity of this test report. Each page necessarily contains the PHOENIX TESTLAB Logo and the TEST REPORT NUMBER.

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1 Identification

Name:	PHOENIX CONTACT Electronics GmbH
Address:	Dringenauer Straße 30, 31812 Bad Pyrmont
Country:	Germany
Name for contact purposes:	Maik STEMME
Phone:	+49 5281 946 3381
eMail address:	mstemme@phoenixcontact.com
Applicant represented during the test by the following person:	-

1.1 Manufacturer

Name:	PHOENIX CONTACT GmbH & Co.KG
Address:	Flachsmarktstr. 8, 32825 Blomberg
Country:	Germany
Name for contact purposes:	Maik STEMME
Phone:	+49 5281 946 3381
eMail address:	mstemme@phoenixcontact.com
Manufacturer represented during the test by the following person:	-

1.2 Test Laboratory

The tests were carried out by:

PHOENIX TESTLAB GmbH
Königswinkel 10
32825 Blomberg
Germany

Accredited by Deutsche Akkreditierungsstelle GmbH (DAkkS) in compliance with DIN EN ISO/IEC 17025 under Reg. No. D-PL-17186-01-05 and D-PL-17186-01-06, FCC Test Firm Designation Number DE0004, FCC Test Firm Registration Number 469623, CAB Identifier DE0003 and ISED# 3469A.

1.3 EUT (Equipment under Test)

	Source (EUT)	Client (Ancillary equipment)
Test object: *	Energy and data coupler (Base)	Energy and data coupler (Remote)
Model name: *	NEARFI P 2A B	NEARFI P 2A R
Article number: *	1234226	1234229
Serial number: *	2036305586	2036305587
FCC ID: *	YG3P2AB	YG3P2AR
ISED certification number: *	4720B-P2AB	4720B-P2AR
PMN: *	NEARFI P 2A B	NEARFI P 2A R
HVIN: *	1234226	1234229
FVIN: *	100	100

* Declared by the applicant

Only one EUT and one ancillary equipment was used for the tests.

Note: PHOENIX TESTLAB GmbH does not take samples. The samples used for tests are provided exclusively by the applicant.

1.4 Technical Data of Equipment

General:			
PCB identifier: *	1184502_03 (Data PCB), 30007741 (Interface PCB), 30007706 (Energy PCB)		
Power supply source (EUT): *	DC		
Supply voltage source (EUT): *	U_{nom} = 24 V_{DC}	U_{min} = 19 V_{DC}	U_{max} = 30 V_{DC}
Power supply client (ancillary): *	DC via WPT from EUT		
Temperature range: *	-20 °C to +65 °C		
Max. Distance between source and client: *	10 mm		
Min. Distance between source and client: *	In touch		

* Declared by the applicant

Energy transfer part source (EUT):	
Frequency: *	100 kHz – 148 kHz
Number of channels: *	-
Type of modulation: *	CW carrier only. No other data (information) is transmitted.
Data rate: *	-
Duty cycle: *	100 %
Antenna type: *	Internal coil
Antenna connector: *	None

* Declared by the applicant

Energy communication part source (EUT)	
Receiver frequency: *	10 MHz
Receiver bandwidth: *	2.1 MHz
Frequency range: *	8.95 MHz to 11.05 MHz
Type of modulation: *	OOK (done by the client)

* Declared by the applicant

Ports/Connectors				
Identification		Connector		Length
NEARFI P 2A B (source)	NEARFI P 2A R (client)	EUT	Ancillary	
Power in	-	5 pole M12 connector	4 mm laboratory plug	3.0 m
-	Power out	5 pole M12 connector	4 mm laboratory plug	3.0 m

*: Length during the test

1.5 Dates

Date of receipt of test sample:	13.06.2022
Start of test:	30.06.2022
End of test:	20.01.2023

2 Operational States

Description of function of the EUT:

The EUT is a device for transmitting energy wireless to a client (NEARFI P 2A R, ancillary) over a distance of a few mm. It is only transmitting energy; the response of the client will be transmitted on 10 MHz and will be received by EUT only. The EUT as well as the client device are intended to operate in industrial environment only.

A pre-test was performed with maximum and minimum distance between the two units, in order to find the worst case of emission. As maximum distance between NEARFI P 2A B (source) to the NEARFI P 2A R (client) 10 mm were found, because with larger distances (up to 12 mm, as stated in the operational description) the maximum current of 2 A could not be transferred. For all tests cases this maximum distance (10 mm) between the two units causing higher emissions than the direct touch of the units. Therefore, the following states were defined as the operating conditions, which are documented in this test report:

- NEARFI P 2A B (source) operates on a standalone base.
- Transfer energy from NEARFI P 2A B (source) to the NEARFI P 2A R (client) in maximum distance (10 mm).

3 Additional Information

The EUT was not labeled as required by FCC / IC.

The results of the NEARFI P 2A R (ancillary, client) were documented in test report F220998E1 of the PHOENIX-TESTLAB GmbH.

4 Overview

Conducted emissions FCC 47 CFR Part 18 section 18.307 (b) [3]					
Application	Frequency range	Limits	Reference standard	Remark	Status
AC supply line	0.15 to 0.5 MHz 0.5 to 5 MHz 5 to 30 MHz	66 to 56 dB(µV) (QP)* 56 to 46 dB(µV) (AV)* 56 dB(µV) (QP) 46 dB(µV) (AV) 60 dB(µV) (QP) 50 dB(µV) (AV)	FCC OST/MP-5 [1]	-	Passed
Conducted emissions ICES-001 Table 1					
Application	Frequency range	Limits	Reference standard	Remark	Status
AC supply line	0.009 to 0.05 MHz 0.05 to 0.150 MHz 0.15 to 0.5 MHz 0.5 to 5 MHz 5 to 30 MHz	110 dB(µV) (QP) 90 to 80 dB(µV) (QP)* 66 to 56 dB(µV) (QP)* 56 to 46 dB(µV) (AV)* 56 dB(µV) (QP) 46 dB(µV) (AV) 60 dB(µV) (QP) 50 dB(µV) (AV)	CAS CISPR 11 [7]	-	Passed
Radiated emissions FCC 47 CFR Part 18 section 18.305 (b) [3]					
Application	Frequency range	Limits	Reference standard	Remark	Status
Radiated Emission	0.009 to 30 MHz 30 MHz to 1 GHz	15 µV/m (23.5 dB(µV)/m) at 300 m	FCC OST/MP-5 [1]	-	Passed
Radiated emissions ICES-001 Table 2 and 4					
Application	Frequency range	Limits at 3 m	Reference standard	Remark	Status
Radiated Emission	0.009 to 0.07 MHz 0.07 to 0.15 MHz 0.15 to 30MHz 30 MHz to 230 MHz 230 MHz to 1 GHz	69 dB(µA/m) (QP) 69 to 39 dB(µA/m) (QP)* 39 to 7 dB(µA/m) (QP)* 40 dB(µV/m) (QP), SAC) 47 dB(µV/m) (QP), SAC)	CAS CISPR 11 [7]	-	Passed

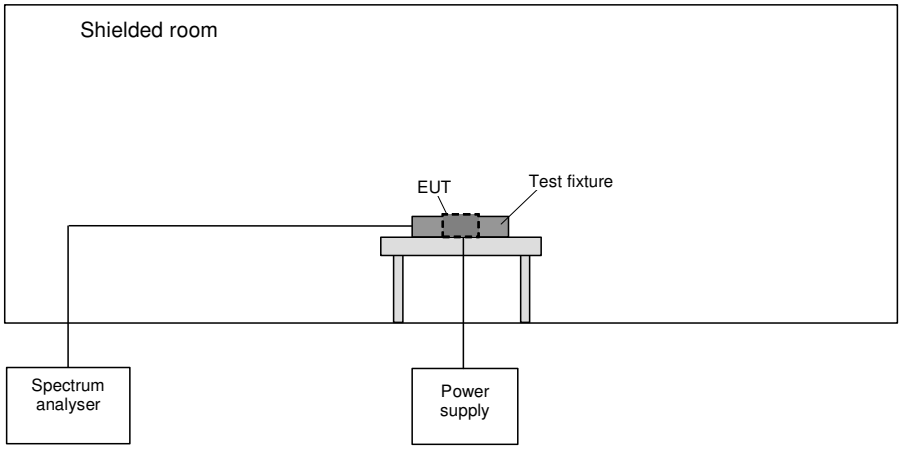
*: Decreases with the logarithm of the frequency

5 Results

5.1 Test setups

5.1.1 Radiated: Test fixture

The test is carried out in a shielded chamber. Table-top devices are set up on a table and the spectrum analyser is connected to a test fixture / loop antenna, which is placed around / on top of the EUT.



5.1.2 Radiated: 9 kHz to 30 MHz

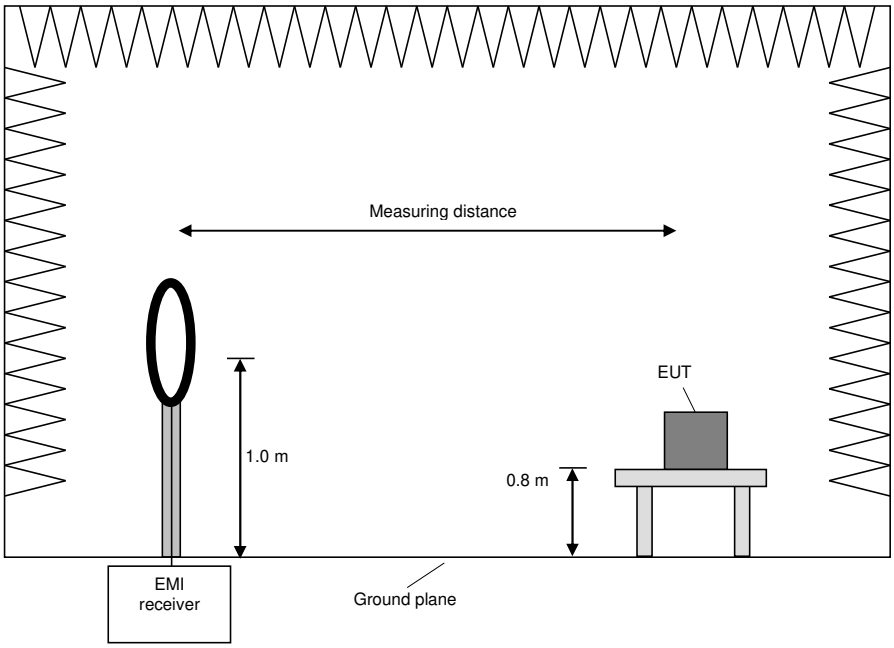
5.1.2.1 Preliminary measurement 9 kHz to 30 MHz

In the first stage a preliminary measurement is performed in a semi-anechoic chamber at a measuring distance of 3 meters. Table-top devices are set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm. Floor-standing devices are placed directly on the turntable / ground plane. The setup of the equipment under test is in accordance with [1].

The frequency range 9 kHz to 30 MHz is monitored with an EMI receiver while the system and its cables are manipulated to find out the configuration with the maximum emission levels if applicable. The EMI receiver is set to MAX hold mode. The EUT and the measuring antenna are rotated around their vertical axis to find the maximum emission levels.

The resolution bandwidth of the EMI receiver is set to the following values:

Frequency range	Resolution bandwidth
9 kHz to 150 kHz	200 Hz
150 kHz to 30 MHz	9 kHz



Procedure preliminary measurement:

Pre-scans are performed in the frequency range 9 kHz to 150 kHz and 150 kHz to 30 MHz.
The following procedure is used:

1) Monitor the frequency range with the measuring antenna facing the EUT and an EUT / turntable azimuth of 0 °.
2) Manipulate the system cables to produce the maximum levels of emissions.
3) Rotate the EUT by 360 ° to maximize the detected signals.
4) Measure the frequencies of the highest detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency values.
5) If the EUT is portable or ceiling mounted, repeat steps 1 to 4 with other orientations (x,y,z) of the EUT.
6) Rotate the measuring antenna and repeat steps 1 to 5.

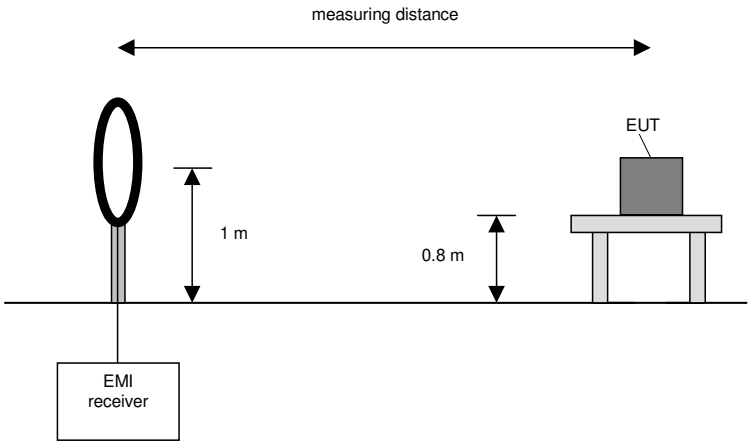
5.1.2.2 Final measurement 9 kHz to 30 MHz

In the second stage a final measurement is performed on an open area test site with no conducting ground plane at a measuring distance of 3 m, 10 m, 30 m or 300 m. If the standard requires larger measuring distances for a given frequency, the results are extrapolated with 1/d, as stated in MP-5 [1]. The final measurement is performed with an EMI receiver set to average detector for FCC measurements and Quasi-Peak for RSS measurements.

At the frequencies, which were detected during the preliminary measurements, the final measurement is performed while rotating the EUT and the measuring antenna in the range of 0 ° to 360 ° around their vertical axis until the maximum level value is found.

The resolution bandwidth of the EMI receiver is set to the following values:

Frequency range	Resolution bandwidth	Measuring time
9 kHz to 150 kHz	200 Hz	1 s
150 kHz to 30 MHz	9 kHz	1 s



Procedure final measurement:

The following procedure is used:

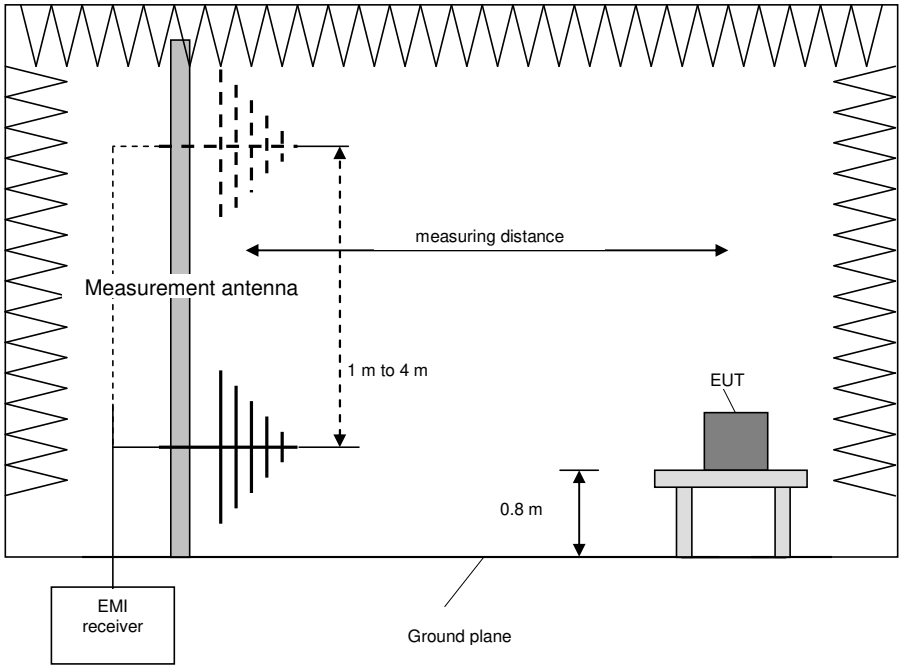
1) Monitor the selected frequencies from the preliminary measurement with the measuring antenna facing the EUT and an EUT azimuth of 0 °.
2) Rotate the EUT by 360 ° to maximize the detected signals.
3) Rotate the measuring antenna and repeat steps 1 to 2 until the maximum value is found and note it.
4) If the EUT is portable or ceiling mounted, repeat steps 1 to 3 with other orientations (x,y,z) of the EUT.

5.1.3 Preliminary and final measurement (30 MHz to 1 GHz)

The preliminary and final measurements were conducted in a semi-anechoic chamber with a metal ground plane. During the test the EUT will be rotated in the range of 0 ° to 360 °, the measuring antenna will be set to horizontal and vertical polarization and raised and lowered in the range from 1 m to 4 m to find the maximum level of emissions.

The resolution bandwidth of the EMI Receiver will be set to the following values:

Test	Frequency range	Resolution bandwidth
Preliminary measurement	30 MHz to 1 GHz	100 kHz
Frequency peak search	+ / - 1 MHz	10 kHz
Final measurement	30 MHz to 1 GHz	120 kHz



Procedure preliminary measurement:

The following procedure is used:

1. Set the measurement antenna to 1 m height.
2. Monitor the frequency range at vertical polarisation and a EUT azimuth of 0 °.
3. Rotate the EUT by 360° to maximize the detected signals.
4. Repeat 1) to 2) with the vertical polarisation of the measuring antenna.
5. Increase the height of the antenna for 0.5 m and repeat steps 2 – 4 until the final height of 4 m is reached.
6. The highest values for each frequency will be saved by the software, including the antenna height, measurement antenna polarization and turntable azimuth for that value.

Procedure final measurement:

The following procedure is used:

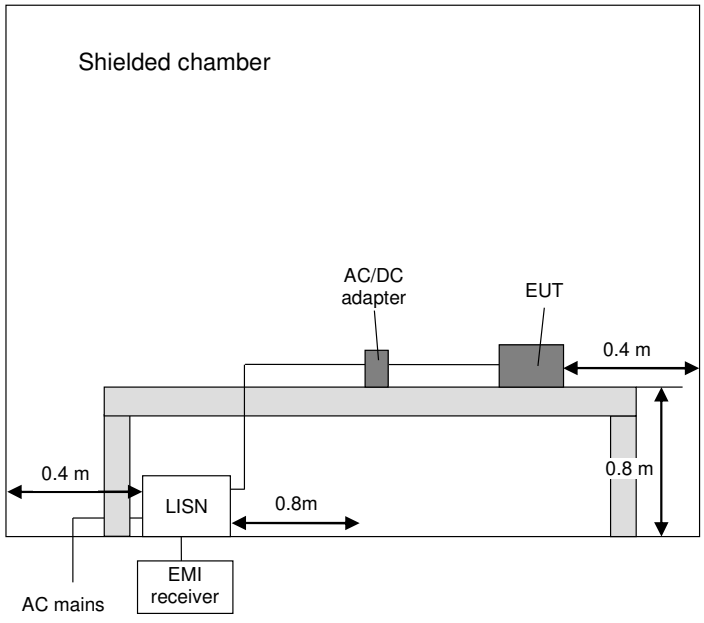
1. Select the highest frequency peaks to the limit for the final measurement.
2. The software will determine the exact peak frequencies by doing a partial scan with reduced RBW with +/- 10 times the RBW of the pre-scan of the selected peaks.
3. If the EUT is portable or ceiling mounted, find the worst case EUT position (x,y,z) for the final test.
4. The worst measurement antenna height is found by the measurement software by varying the measurement antenna height by +/- 0.5 m from the value obtained in the preliminary measurement, and to monitor the emission level.
5. The worst azimuth turntable position is found by varying the turntable azimuth by +/- 30° from the value obtained in the preliminary measurement, and to monitor the emission level.
6. The final measurement is performed at the worst case antenna height and the worst case turntable azimuth
7. Steps 2 – 6 will be repeated for each frequency peak selected in step 1.

5.1.4 Conducted emission: AC power line

The test is carried out in a shielded chamber. Table-top devices are set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm above the ground plane. Floor-standing devices are placed directly on the ground plane. In case of DC powered equipment, which is not exclusively powered by a battery, it is connected to the LISN via a suitable AC/DC adaptor. The setup of the equipment under test is in accordance with [1].

The frequency range 150 kHz to 30 MHz is measured with an EMI receiver set to MAX hold mode with Peak and Average detectors and a resolution bandwidth of 9 kHz. A scan is carried out on the phase and neutral line of the AC mains network. If emissions less than 10 dB below the appropriable limit are detected, these emissions are measured with an Average and Quasi-peak detector on all lines.

Frequency range	Resolution bandwidth	Measuring time
150 kHz to 30 MHz	9 kHz	5 s



5.1.5 Test setup (99 % bandwidth)

Test setup (99 % bandwidth)			
Used	Setup	See sub-clause	Comment
☒	Radiated: Test fixture	5.1.1	-
☐	Test setup (antenna port conducted)	-	-

5.1.1 Test method (99 % bandwidth)

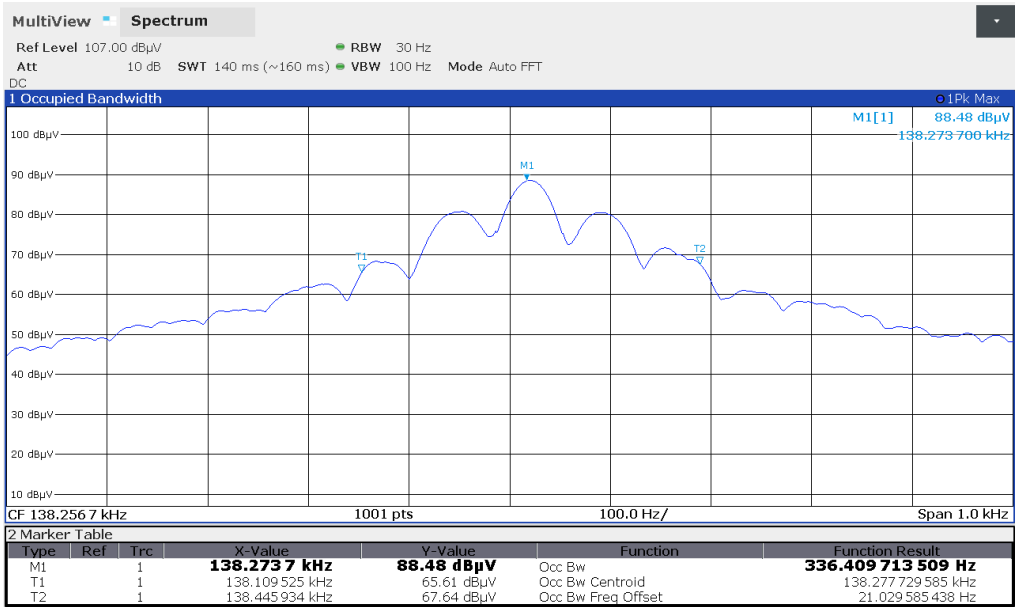
Test method (99 % bandwidth)				
Used	Sub-Clause [1]	Name of method	Applicability	Comment
☒	6.9.2	Occupied bandwidth – power bandwidth (99%) measurement procedure	-	-

5.1.2 Test results (99 % bandwidth)

Ambient temperature:	22 °C
Relative humidity:	62 %

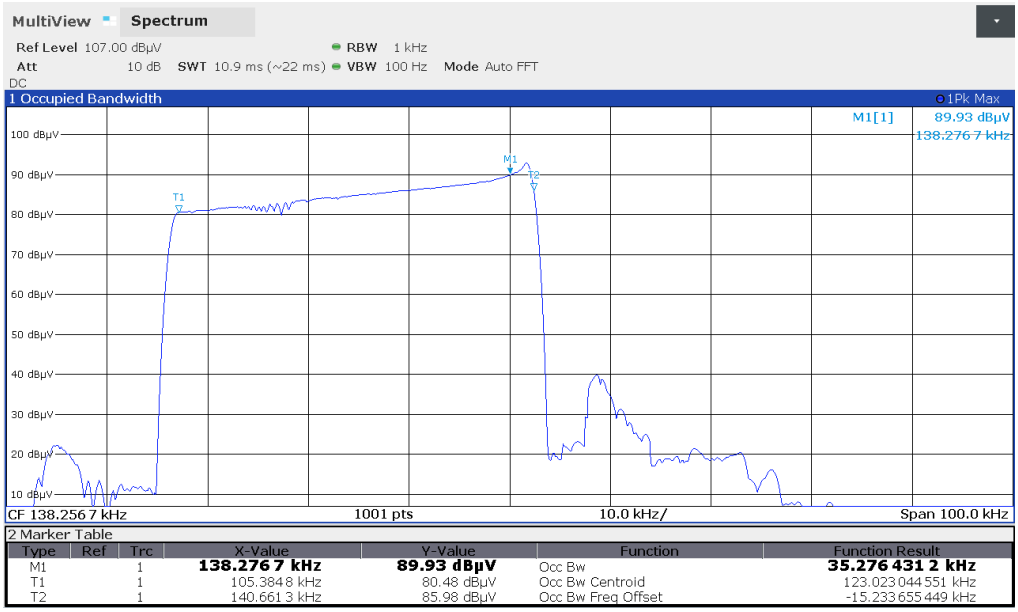
Date:	17.08.2022
Tested by:	W. Kasalowsky

The EUT has found its transmission frequency for a separation distance of 10 mm between base and remote and an output current of 2 A at remote.



F_L	F_U	BW (F_U - F_L)
138.110 kHz	138.446 kHz	0.336 kHz

Separation distance between base and remote is varied from 0 mm to 10 mm and output current at remote is varied from 0 A to 2 A.



F_L	F_U	BW (F_U - F_L)
105.385 kHz	140.661 kHz	35.276 kHz

Test result: Passed

Test equipment (please refer to chapter 7 for details)
11, 16, 17, 19, 21

5.2 AC power line conducted emissions

5.2.1 Test setup (AC power line conducted emissions)

Test setup (Conducted emissions on power supply lines)			
Used	Setup	See sub-clause	Comment
☒	Conducted: AC power line	5.1.4	-
☐	Not applicable, because …	-	-

5.2.2 Test method (AC power line conducted emissions)

Test setup (Conducted emissions on power supply lines)				
Used	Clause [1]	Name of method	Sub-clause	Comment
☒	6.2	Tabletop equipment testing	5.1.3	Provided AC switching power adaptor
☐	6.2	Floor-standing equipment testing	-	-

The AC power adaptor provided by the applicant was used for the tests:
HC24-2.4-AG from bel power solutions.
The power adaptor itself was supplied by 120 V_{AC} 60 Hz.

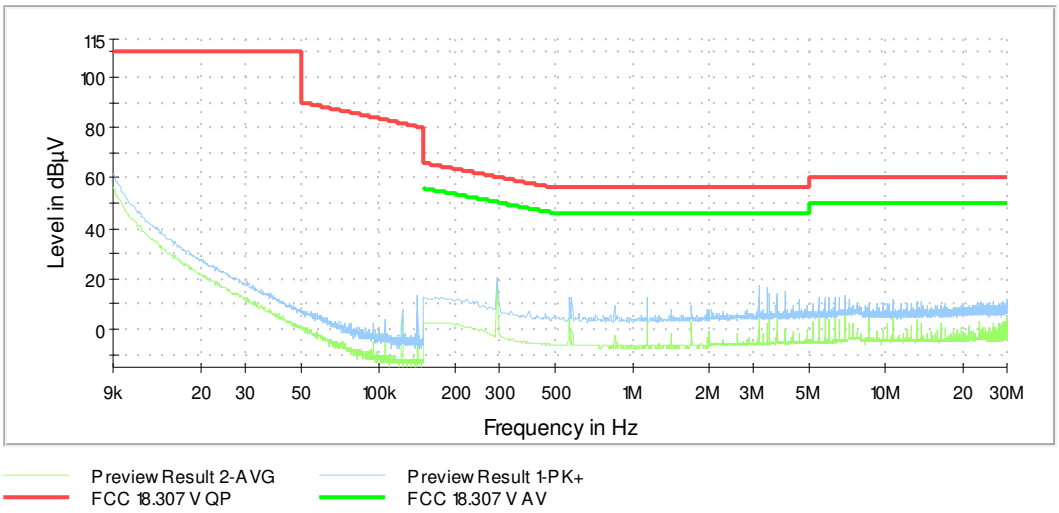
5.2.3 Results of conducted emission measurement on AC mains

Ambient temperature:	21 °C
Relative humidity:	30 %

Date:	20.01.2023
Tested by:	Th. Kühn

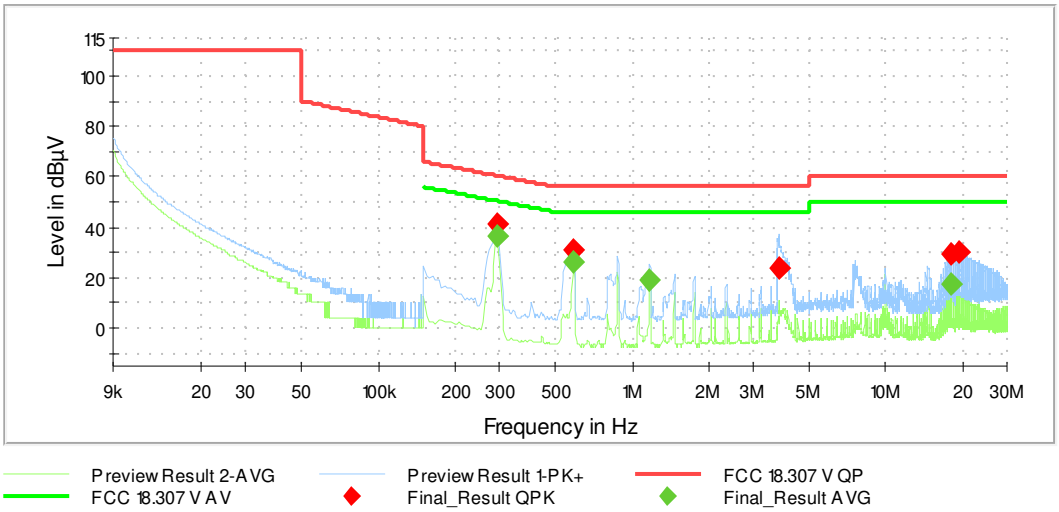
The curves in the diagrams below only represent for each frequency point the maximum measured value of all preliminary measurements which were made for each power supply line. The top measured curve represents the peak measurement and the bottom measured curve the average measurement. The Quasi-peak measured points are marked by and the average measured ◆ points by ▼.

NEARFI P 2A B (source, EUT) without client:



All emissions are at least 20 dB below the limit, so no final measurement was carried out.

NEARFI P 2A B (source, EUT) and NEARFI P 2A R (client, ancillary):



Frequency [MHz]	Result Quasi-peak [dB(µV)]	Result average [dB(µV)]	Limit [dB(µV)]	Margin [dB]	Line	PE
0.293100	---	36.7	50.4	13.7	L1	GND
0.293100	41.2	---	60.4	19.2	L1	FLO
0.585600	---	26.1	46.0	19.9	L1	GND
0.587400	31.1	---	56.0	24.9	L1	GND
1.173300	---	19.5	46.0	26.5	L1	FLO
3.756300	23.6	---	56.0	32.4	L1	GND
18.182400	---	17.8	50.0	32.2	N	FLO
18.186900	29.5	---	60.0	30.5	N	GND
19.358700	30.1	---	60.0	29.9	N	GND

Test result: Passed

Test equipment (please refer to chapter 7 for details)
12 – 15, 19, 22

5.3 Radiated emissions

5.3.1 Test setup (Maximum unwanted emissions)

Test setup (Maximum unwanted emissions)			
Used	Setup	See sub-clause	Comment
☒	Radiated: 9 kHz to 30 MHz / 30 MHz to 1 GHz	5.1.2 / 5.1.3	-

5.3.2 Test method (Maximum unwanted emissions)

Used	Sub-Clause	Name of method	Applicability	Comment
☒	5.1.2 to 5.1.3	Unwanted radiated emissions	No limitations	-

5.3.3 Test results (Maximum unwanted emissions)

5.3.3.1 Test results preliminary measurement 9 kHz to 30 MHz

Ambient temperature:	23 °C
Relative humidity:	51 %

Date:	07.07.2022
Tested by:	W. Kasalowsky

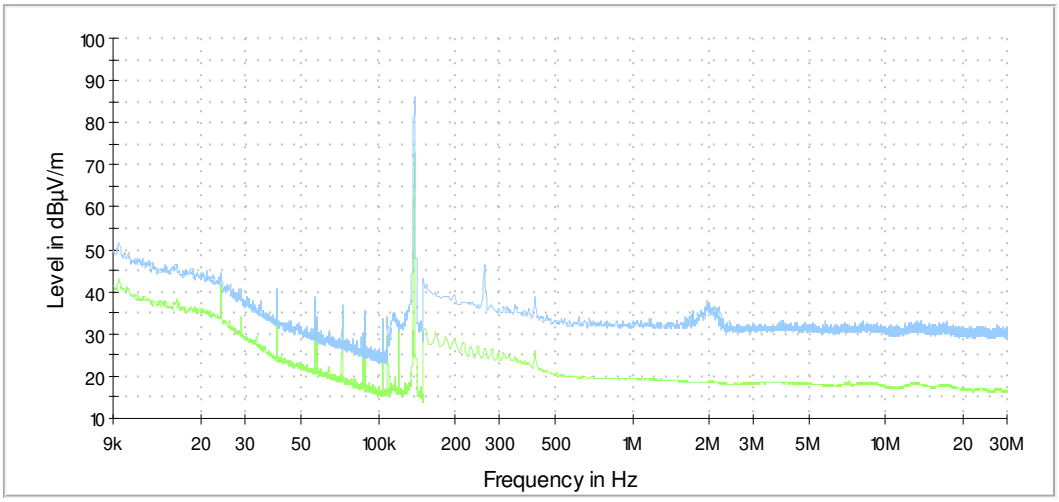
Position of EUT: For tests for f between 9 kHz to 30 MHz, the EUT was set-up on a table with a height of 80 cm. The distance between EUT and antenna was 3 m.

Cable guide: For detail information of test set-up and the cable guide refer to the pictures in the annex A in the test report.

Remark: All 3 orthogonal planes were tested separately, the plots below a showing the maximum of all positions.

Spurious emissions from 9 kHz to 30 MHz:

NEARFI P 2A B (source, EUT) without client:



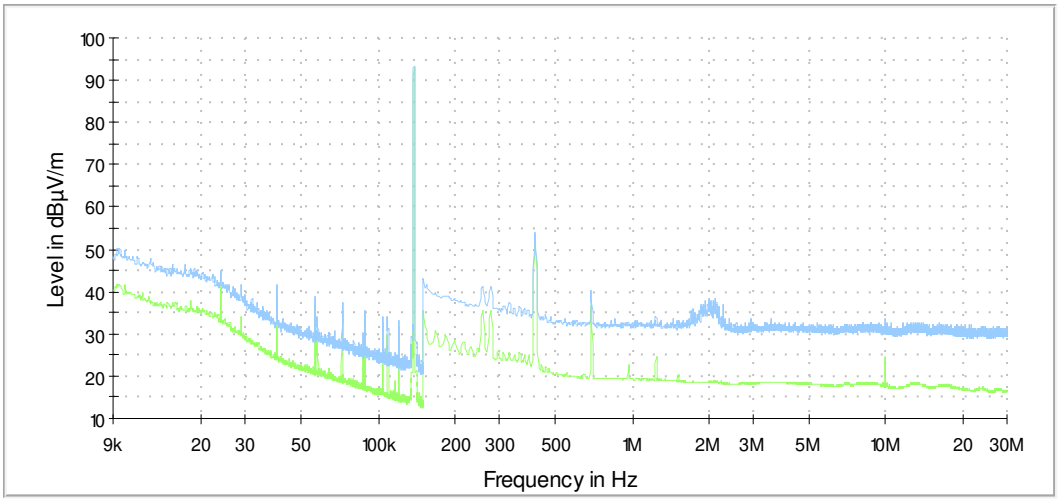
During the preliminary measurement, the following emissions were found:

138 kHz, 263 kHz, 416 kHz and 2,092 MHz.

On these frequencies a final measurement on an outdoor test site has to be carried out. The results of this final measurement are presented in 5.3.3.2 of this test report.

NEARFI P 2A B (source, EUT) and NEARFI P 2A R (client, ancillary):

Separation distance of 10 mm between source and client and output current of 2 A at remote.



During the preliminary measurement, the following emissions were found:

138 kHz, 258 kHz, 276 kHz, 416 kHz, 690 kHz and 2.009 MHz.

On these frequencies a final measurement on an outdoor test site has to be carried out. The results of this final measurement are presented in 5.3.3.2 of this test report.

Test equipment (please refer to chapter 7 for details)
3 – 5, 7 – 11, 19, 21

5.3.3.2 Test results final measurement 9 kHz to 30 MHz

Ambient temperature:	23 °C
Relative humidity:	51 %

Date:	07.07.2022
Tested by:	W. Kasalowsky

The results of the standard subsequent measurement at the outdoor test site are indicated in the tables below.

Calculations:
Result @ norm. dist. [dB(µV/m)] = Reading [dB(µV)] + AF [dB/m] + Distance corr. fact. (if applicable) [dB]
Result @ norm. dist. [dB(µA/m)] = Result @ norm. dist. [dB(µV/m)] – 20 x $\log_{10}$ (377 Ω)
Margin [dB] = Limit [dB(µV|µA)/m)] - Result [dB(µV|µA)/m]

NEARFI P 2A B (source, EUT) without client according to 47 CFR 18.305 (b):

The wanted signal was measured with two different measuring distances in order to calculate a distance correction factor. For all other distances a distance correction factor of 20 dB / decade (1/d) was used.

Frequency [MHz]	Level at 3 m distance (AV) [dB(µV)]	Level at 10 m distance (AV) [dB(µV)]	Difference from 3 to 10 m [dB]	Distance correction factor [dB/decade]
0.138	39.6	9.3	30.3	60.6

The limits as well as the measured results (levels) refer to 47 CFR 18.305 (b) while taking in account the specified requirements for a 3 | 300 m measuring distance.

Results 9 kHz - 30 MHz										
Frequency [MHz]	Reading @ measuring distance [dB(µV)]	Result @ norm. distance [dB(µV/m)]	Limit acc. 18.305 [dB(µV/m)]	Margin [dB]	Detector	Antenna factor [dB/m]	Measuring distance [m]	Normative distance [m]	Distance correction factor * [dB]	Position #
0.138	39.6	-61.3	23.5	84.8	CAV	20.3	3	300	-121.2	1
0.263	6.6	-13.2	23.5	36.7	CAV	20.2	3	300	-40.0	1
0.416	3.4	-16.4	23.5	39.9	CAV	20.2	3	300	-40.0	1
2.092	-2.4	-22.2	23.5	45.7	CAV	20.2	3	300	-40.0	1

*: Distance correction according to ANSI C63.10 clause 6.4.4.2 [1].

The limits as well as the measured results (levels) refer to RSS-216 / ICES-001 table 2. while taking into account the specified requirements for a 3 m measuring distance.

Results 9 kHz - 30 MHz										
Frequency [MHz]	Reading @ measuring distance [dB(µV)]	Result @ norm. distance [dB(µV/m)]	Result @ norm. distance [dB(µA/m)]	Limit acc. ICES-001 Table 2 [dB(µA/m)]	Margin [dB]	Detector	Antenna factor [dB/m]	Measuring distance [m]	Normative distance [m]	Position #
0.138	60.8	81.1	29.6	42.3	12.7	QP	20.3	3	3	1
0.263	11.9	32.1	-19,4	35.8	55.2	QP	20.2	3	3	1
0.416	10.8	31.0	-20,5	32.8	53.3	QP	20.2	3	3	1
2.092	3.8	24.0	-27.5	23.1	50.6	QP	20.2	3	3	1

NEARFI P 2A B (source, EUT) and NEARFI P 2A R (client, ancillary):

Separation distance of 10 mm between source and client and output current of 2 A at remote.

The wanted signal was measured with two different measuring distances in order to calculate a distance correction factor. For all other distances a distance correction factor of 20 dB / decade (1/d) was used.

Frequency [MHz]	Level at 3 m distance (AV) [dB(µV)]	Level at 10 m distance (AV) [dB(µV)]	Difference from 3 to 10 m [dB]	Distance correction factor [dB/decade]
0.138	65.0	34.5	30.5	61.0

The limits as well as the measured results (levels) refer to 47 CFR 18.305 (b) while taking into account the specified requirements for a 3 | 10 m measuring distance.

Results 9 kHz - 30 MHz										
Frequency	Reading @ measuring distance	Result @ norm. distance	Limit acc. 18.305	Margin	Detector	Antenna factor	Measuring distance	Normative distance	Distance correction factor *	Position
[MHz]	[dB(µV)]	[dB(µV/m)]	[dB(µV/m)]	[dB]		[dB/m]	[m]	[m]	[dB]	#
0.138	65.0	-36.7	23.5	60.2	CAV	20.3	3	300	-122.0	1
0.258	14.8	-5.0	23.5	28.5	CAV	20.2	3	300	-40.0	1
0.276	15.4	-4.4	23.5	27.9	CAV	20.2	3	300	-40.0	1
0.416	33.1	13.3	23.5	10.2	CAV	20.2	3	300	-40.0	1
0.690	16.3	-3.5	23.5	27.0	CAV	20.2	3	300	-40.0	1
2.009	-2.1	-21.9	23.5	45.4	CAV	20.2	3	300	-40.0	1

*: Distance correction according to ANSI C63.10 clause 6.4.4.2 [1].

The limits as well as the measured results (levels) refer to RSS-216 / ICES-001 table 2. while taking in account the specified requirements for a 3 m measuring distance.

Results 9 kHz - 30 MHz										
Frequency	Reading @ measuring distance	Result @ norm. distance	Result @ norm. distance	Limit acc. ICES-001 Table 2	Margin	Detector	Antenna factor	Measuring distance	Normative distance	Position
[MHz]	[dB(µV)]	[dB(µV/m)]	[dB(µA/m)]	[dB(µA/m)]	[dB]		[dB/m]	[m]	[m]	#
0.138	72.6	92.9	41.4	42.3	0.9	QP	20.3	3	3	1
0.258	17.3	37.5	-14.0	35.7	49.7	QP	20.2	3	3	1
0.276	17.9	38.1	-13.4	35.3	48.7	QP	20.2	3	3	1
0.416	33.3	53.5	2.0	32.8	30.8	QP	20.2	3	3	1
0.690	17.4	37.6	-13.9	29.8	43.7	QP	20.2	3	3	1
2.009	3.8	24.0	-27.5	23.3	50.8	QP	20.2	3	3	1

Test result: Passed

Test equipment (please refer to chapter 7 for details)
3, 11, 18 – 21

5.3.3.3 Test results preliminary measurement 30 MHz to 1 GHz

Ambient temperature:	24 °C
Relative humidity:	61 %

Date:	30.06.2022
Tested by:	W. Kasalowsky

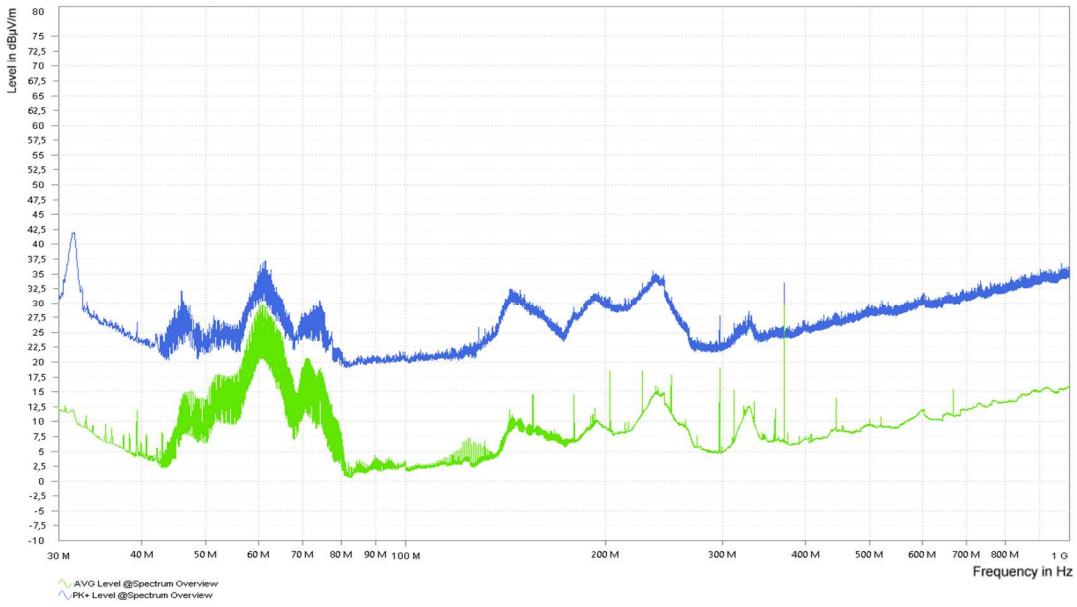
Position of EUT: For tests for f between 30 MHz to 1 GHz, the EUT was set-up on a table with a height of 80 cm. The distance between EUT and the antenna was 3 m.

Cable guide: For detail information of test set-up and the cable guide refer to the pictures in the annex A in the test report.

Test record: Plots for each frequency range are submitted below.

Remark: All 3 orthogonal planes were tested separately

NEARFI P 2A B (source, EUT) without client:



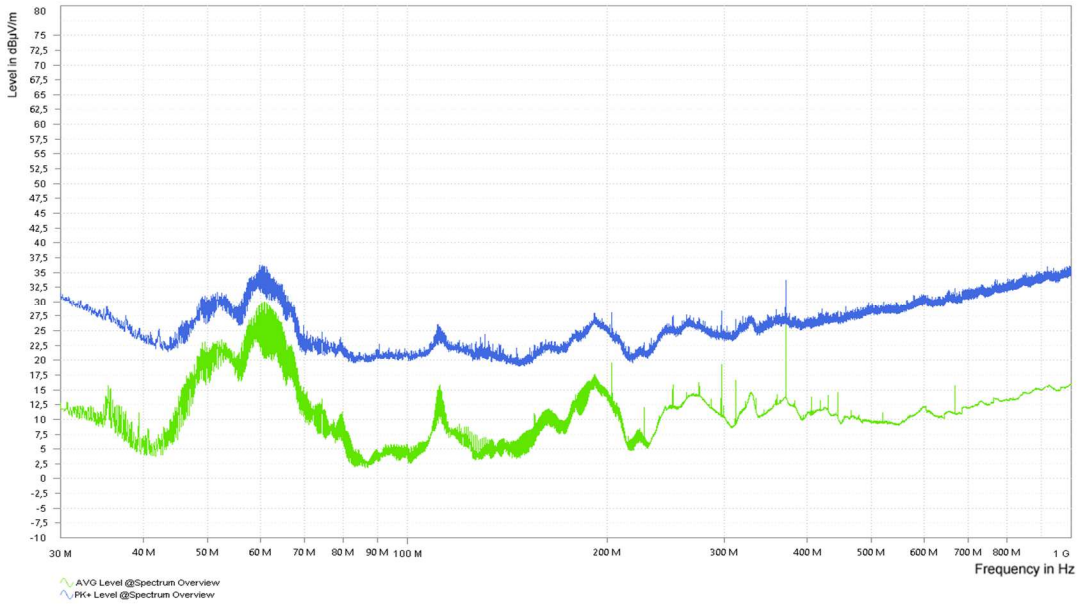
During the preliminary measurement, the following emissions were found:

31.410 MHz, 45.960 MHz, 61.290 MHz, 143.490 MHz, 235.830 MHz, 371.280 MHz and 972.810MHz.

On these frequencies a final measurement has to be carried out. The results of this final measurement are presented in 5.3.3.4 of this test report.

NEARFI P 2A B (source, EUT) and NEARFI P 2A R (client, ancillary):

Separation distance of 10 mm between source and client and output current of 2 A at remote.



During the preliminary measurement, the following emissions were found:

60.150 MHz, 191.580 MHz, 203.250 MHz, 297.030 MHz, 371.280 MHz, 668.280 MHz and 994.050 MHz.

On these frequencies a final measurement has to be carried out. The results of this final measurement are presented in 5.3.3.4 of this test report.

Test equipment (please refer to chapter 7 for details)
1, 2 ,4 – 11, 19, 21

5.3.3.4 Test results final measurement 30 MHz to 1 GHz

Ambient temperature:	24 °C
Relative humidity:	61 %

Date:	30.06.2022
Tested by:	W. Kasalowsky

The results of the standard subsequent measurement inside the semi anechoic chamber are indicated in the tables below. The measurement was carried out with a 3 m measurement distance, measured with the Quasi-peak and average detector with a measuring time of 1 s. If applicable a distance correction factor of 20 dB / decade (1/d) was used.

Calculations:
Result [dB(µV/m)] = Reading [dB(µV)] + Correction [dB/m] + Distance corr. fact. (if applicable) [dB]
Correction [dB] = AF [dB/m] + Cable attenuation [dB] + optional preamp gain [dB]
Margin [dB] = Limit [dB(µV/m)] - Result [dB(µV/m)]

NEARFI P 2A B (source, EUT) without client:

The limits as well as the measured results (levels) refer to 47 CFR 18.305 (b) while taking into account the specified requirements for a 3 m measuring distance.

Results 30 MHz – 1 GHz											
Frequency [MHz]	Reading @ measuring distance [dB(µV)]	Result (AV) @ norm. distance [dB(µV/m)]	Limit acc. 18.305 [dB(µV/m)]	Margin [dB]	Correction [dB/m]	Normative distance [m]	Distance correction factor * [dB]	Height [m]	Azimuth [deg]	Pol.	Position #
31.410	-13.1	-28.0	23.5	51.5	25.1	300.0	-40.0	1.75	270	Hor.	1
45.960	-2.4	-26.1	23.5	49.6	16.3	300.0	-40.0	1.00	111	Vert.	1
61.290	16.9	-10.5	23.5	34.0	12.6	300.0	-40.0	1.75	201	Vert.	1
143.490	-4.1	-28.3	23.5	51.8	15.8	300.0	-40.0	2.27	261	Hor.	1
235.830	-2.7	-25.6	23.5	49.1	17.1	300.0	-40.0	1.25	105	Hor.	1
371.280	8.5	-10.3	23.5	33.8	21.2	300.0	-40.0	1.00	201	Vert.	1
972.810	-15.2	-24.5	23.5	48.0	30.7	300.0	-40.0	3.75	140	Hor.	1

The limits as well as the measured results (levels) refer to RSS-216 / ICES-001 table 2, while taking into account the specified requirements for a 3 m measuring distance.

Results 30 MHz – 1 GHz											
Frequency [MHz]	Reading @ measuring distance [dB(µV)]	Result (QP) @ norm. distance [dB(µV/m)]	Limit acc. ICES-001 Table 4 [dB(µV/m)]	Margin [dB]	Correction [dB/m]	Normative distance [m]	Distance correction factor * [dB]	Height [m]	Azimuth [deg]	Pol.	Position #
31.410	-8.5	16.6	40.0	23.4	25.1	3.0	0	1.75	270	Hor.	1
45.960	2.4	18.7	40.0	21.3	16.3	3.0	0	1.00	111	Vert.	1
61.290	19.5	32.1	40.0	7.9	12.6	3.0	0	1.75	201	Vert.	1
143.490	8.4	24.2	40.0	15.8	15.8	3.0	0	2.27	261	Hor.	1
235.830	10.6	27.7	47.0	19.3	17.1	3.0	0	1.25	105	Hor.	1
371.280	9.5	30.7	47.0	16.3	21.2	3.0	0	1.00	201	Vert.	1
972.810	-8.6	22.1	47.0	24.9	30.7	3.0	0	3.75	140	Hor.	1

NEARFI P 2A B (source, EUT) and NEARFI P 2A R (client, ancillary):

Separation distance of 10 mm between source and client and output current of 2 A at remote.

The limits as well as the measured results (levels) refer to 47 CFR 18.305 (b) while taking into account the specified requirements for a 3 m measuring distance.

Results 30 MHz – 1 GHz											
Frequency	Reading @ measuring distance	Result (AV) @ norm. distance	Limit acc. 18.305	Margin	Correction	Normative distance	Distance correction factor *	Height	Azimuth	Pol.	Position
[MHz]	[dB(µV)]	[dB(µV/m)]	[dB(µV/m)]	[dB]	[dB/m]	[m]	[dB]	[m]	[deg]		#
60.150	17.4	-10.2	23.5	33.7	12.4	300	-40.0	1.53	201	Vert.	1
191.580	1.3	-23.5	23.5	47.0	15.2	300	-40.0	1.77	292	Hor.	1
203.250	3.5	-20.5	23.5	44.0	16.0	300	-40.0	1.54	291	Hor.	1
297.030	0.1	-20.9	23.5	44.4	19.0	300	-40.0	2.75	351	Vert.	1
371.280	9.3	-9.5	23.5	33.0	21.2	300	-40.0	1.00	67	Vert.	1
668.280	-11.4	-24.3	23.5	47.8	27.1	300	-40.0	1.89	134	Hor.	1
994.050	-15.0	-24.2	23.5	47.7	30.8	300	-40.0	3.27	126	Hor.	1

The limits as well as the measured results (levels) refer to RSS-216 / ICES-001 table 2. while taking in account the specified requirements for a 3 m measuring distance.

Results 30 MHz – 1 GHz											
Frequency	Reading @ measuring distance	Result (QP) @ norm. distance	Limit acc. ICES-001 Table 4	Margin	Correction	Normative distance	Distance correction factor *	Height	Azimuth	Pol.	Position
[MHz]	[dB(µV)]	[dB(µV/m)]	[dB(µV/m)]	[dB]	[dB/m]	[m]	[dB]	[m]	[deg]		#
60.150	20.8	33.2	40.0	6.8	12.4	3.0	0	1.53	201	Vert.	1
191.580	7.1	22.3	40.0	21.2	15.2	3.0	0	1.77	292	Hor.	1
203.250	7.7	23.7	40.0	19.8	16.0	3.0	0	1.54	291	Hor.	1
297.030	3.9	22.9	47.0	24.1	19.0	3.0	0	2.75	351	Vert.	1
371.280	10.2	31.4	47.0	15.6	21.2	3.0	0	1.00	67	Vert.	1
668.280	-5.7	21.4	47.0	25.6	27.1	3.0	0	1.89	134	Hor.	1
994.050	-8.1	22.7	47.0	24.3	30.8	3.0	0	3.27	126	Hor.	1

Test result: Passed

Test equipment (please refer to chapter 7 for details)
1, 2 ,4 – 11, 19, 21

6 Measurement Uncertainties

Conducted measurements		
Measurement method	Standard used for calculating measurement uncertainty	Expanded measurement uncertainty (95 %) U_{lab}
Bandwidth measurements	-	9.0×10^{-8}
Conducted emissions from 9 kHz to 150 MHz with LISN	CISPR 16-4-2	3.8 dB
Conducted emissions from 150 kHz to 30 MHz with LISN	CISPR 16-4-2	2.8 dB

Radiated measurements		
Bandwidth measurements		
(Semi-) Anechoic chamber	-	9.0×10^{-8}
OATS	-	9.0×10^{-8}
Test fixture	-	9.1×10^{-8}
Radiated field strength M276		
R&S HL562E @ 3 m 30 MHz – 1 GHz	CISPR 16-4-2	4.8 dB
OATS		
Field strength measurements below 30 MHz on OATS without ground plane	-	4.4 dB

7 Test Equipment used for Tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal Due
1	Attenuator 6 dB	WA2-6	Weinschel	-	482793	Calibration not necessary	
2	Ultralog Antenna	HL562E	Rohde & Schwarz	101079	482978	18.03.2021	03.2024
3	Loop antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059	22.02.2022	02.2024
4	RF Switch Matrix	OSP220	Rohde & Schwarz		482976	Calibration not necessary	
5	Turntable	TT3.0-3t	Maturo	825/2612/.01	483224	Calibration not necessary	
6	Antennasupport	BAM 4.5-P-10kg	Maturo	222/2612.01	483225	Calibration not necessary	
7	Controller	NCD	Maturo	474/2612.01	483226	Calibration not necessary	
8	Semi Anechoic Chamber M276	SAC5-2	Albatross Projects	C62128-A540-A138-10-0006	483227	Calibration not necessary	
9	Test software M276	Elektra V4.42	Rohde & Schwarz	101381	483755	Calibration not necessary	
10	EMI Testreceiver	ESW44	Rohde & Schwarz	101828	482979	08.12.2021	12.2023
11	Power Supply	TOE8852 (DC)	Toellner	51712	480233	Calibration not necessary	
12	LISN	NSLK8128	Schwarzbeck	8128161	480138	15.02.2022	02.2024
13	Transient Filter Limiter	CFL 9206A	Teseq GmbH	38268	481982	15.02.2022	02.2024
14	Shielded chamber M4	B83117-S1-X158	Siemens	190075	480088	Calibration not necessary	
15	EMI Receiver / Spectrum Analyser	ESIB 26	Rohde & Schwarz	100292	481182	16.02.2022	02.2024
16	Signal & Spectrum Analyzer	FSW43	Rohde & Schwarz	100586 & 100926	481720	19.11.2021	11.2022
17	Loop antenna	Loop antenna 22.5cm	PHOENIX TESTLAB	-	410085	Calibration not necessary	
18	EMI Receiver / Spectrum Analyser	ESR7	Rohde & Schwarz	101733	482330	02.06.2022	02.2024
19	Load resistor	600x65 - 27 SZZL	FRIZLEN	36324	482420	Calibration not necessary	
20	Outdoor test site	-	PHOENIX TESTLAB	-	480293	Calibration not necessary	
21	Multimeter	971A	Hewlett Packard	JP39009358	480721	30.03.2022	03.2023
22	Software	EMC32	Rohde & Schwarz	100061	481022	Calibration not necessary	

8 Test site Verification

Test equipment	PM. No.	Frequency range	Type of validation	According to	Val. Date	Val Due
Shielded chamber M4	480088	9 kHz – 30 MHz	GND-Plane	ANSI C63.4-2014	08.11.2022	07.11.2024
OATS Outdoor	480293	9 kHz – 30 MHz	-	ANSI C63.4-2014	-	-
Semi anechoic chamber M276	483227	30 – 1000 MHz	NSA/RSM	CISPR 16-1-4 + Cor1:2010 + A1:2012 +A2:2017	03.03.2021	02.03.2023

9 Report History

Report Number	Date	Comment
F220997E2	02.06.2023	Initial Test Report
F220997E2, 2nd version	22.11.2023	HVIN and FVIN corrected and editorial changes
-	-	-

10 List of Annexes

Annex A Test setup photos 8 pages