Bundesnetzagentur
BNetzA-CAB-14/21-09

DAkkS Deutsche Akkreditierungsstelle D-PL-11020-03-01

SGS Germany GmbH

Test Report No.: P0GN0003

Replacement of Test Report: P0GN0002

FCC ID: 2AVOXFZEV

Order No.: P0GN **Pages:** 40

Client:	Fazua GmbH Testing Department
Equipment Under Test:	Drive system including motor and battery for Pedelec (EPAC)
Manufacturer / Importer:	Fazua GmbH
Task:	Compliance with the requirements mentioned below:
Test Specification(s): [covered by accreditation]	• FCC 47 CFR Part 15 §15.107 §15.109 • ICES -003 Issue 6
Result:	The EUT complies with the requirements of the test specifications.

The results relate only to the items tested as described in this test report.

edited by:	**Date**	**Signature**
Ratkovic Qualification Engineer	Sep 28, 2020	
approved by:	**Date**	**Signature**
Wössner Group Leader	Sep 28, 2020	

This document was signed electronically.

CONTENTS

1 Result Summary

This report replaces test report P0GN0002. Following changes have been made compared to report P0GN0002:

1. FCC ID number added on the first page.
2. Clarification of units under test
3. Update blockdiagrams with clock frequencies
4. Typographical correction of charger parameters

This report presents the test procedures used and the results obtained during the performance of an FCC 47 CFR Part 15 and ICES-003 test program. The test program was conducted to assess the ability of the tested sample to successfully satisfy the requirements specified in the references listed in Section 2 of this report.

Tables of Results:

Phenomena	Reference	Frequency range	Criteria	Verdict [1]
Conducted Emission AC power port [2]	FCC 47 CFR Part 15 §15.107	150 kHz – 30 MHz	Class B	P
Radiated Emission Electric Field	FCC 47 CFR Part 15 §15.109	30 MHz - 1 GHz	Class B	P
Radiated Emission Electric Field	FCC 47 CFR Part 15 §15.109	1 GHz - 26 GHz [3]	Class B	P
Conducted Emission AC power port[2]	ICES-003	150 kHz – 30 MHz	Class B	P
Radiated Emission Electric Field	ICES-003	30 MHz - 1 GHz	Class B	P
Radiated Emission Electric Field	ICES-003	1 GHz - 26 GHz[3]	Class B	P

[1] **P** (Pass): test object meets the requirement; **F** (Fail): test object does not meet the requirement; **NA**: test case does not apply to the test object; **NR**: test case is not requested by the client; **NP**: test case was not performed

[2] According ANSI C.63.4 chapter 7.1: If the EUT normally receives power from another device that in turn connects to the public-utility ac power lines, measurements shall be made on that device with the EUT in operation to ensure that the device continues to comply with the appropriate limits while providing the EUT with power. If the EUT is operated only from internal or dedicated batteries, with no provisions for connection to the public utility ac power lines (600 VAC or less) to operate the EUT (such as an adapter), then ac power-line conducted measurements are not required.

[3] See chapt. 4.2.4; Clock frequencies of the EUT resulting in determination of frequency range

2 References

2.1 Specification(s)

[1] FCC 47 CFR Part 15:
Code of Federal Regulations. Title 47: Telecommunication Part 15: Radio Frequency Devices

[2] 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

[3] FCC Public Notice DA 09-2478; Nov 25, 2009; Office of Engineering and Technology Clarifies Use of Recently Published ASC C63®
Measurement Standards for Compliance Testing of Intentional and Unintentional Radiators under Part 15

[4] Industry Canada ICES-003 Issue 6; Information Technology Equipment (ITE) – Limits and methods of measurement

2.2 Glossary

AC	Alternating Current
AMN	Artificial Mains Network
AV	Average Detector
DC	Direct Current
EMC	Electromagnetic Compatibility
EUT	Equipment Under Test
HW	Hardware
LISN	Line Impedance Stabilization Network
QP	Quasi Peak Detector

2.3 Information concerning FCC Equipment Authorization and Labelling

CERTIFICATION (47 CFR Section 2.907)
Certification is the most rigorous approval process for RF Devices with the greatest potential to cause harmful interference to radio services. It is an equipment authorization issued by an FCC-recognized Telecommunication Certification Body (TCB) based on an evaluation of the supporting documentation and test data submitted by the responsible party (e.g., the manufacturer or importer) to the TCB. Testing is performed by an FCC-recognized accredited testing laboratory. Information including the technical parameters and descriptive information for all certified equipment is posted on a Commission-maintained public database. In addition, equipment subject to approval using the Supplier's Declaration of Conformity (SDoC) procedure can optionally use the Certification procedure.

SUPPLIER'S DECLARATION OF CONFORMITY (47 CFR Section 2.906) → SDoC
Supplier's Declaration of Conformity (SDoC) is a procedure that requires the party responsible for compliance ensure that the equipment complies with the appropriate technical standards. The responsible party, who must be located in the United States, is not required to file an equipment authorization application with the Commission or a TCB. Equipment authorized under the SDoC procedure is not listed in a Commission database. However, the responsible party or any other party marketing the equipment must provide a test report and other information demonstrating compliance with the rules upon request by the Commission. The responsible party has the option to use the certification procedure in place of the SDoC procedure.

The key FCC rule sections for SDoC are:
a. Section 2.906 Supplier's Declaration of Conformity
b. Section 2.909 Responsible party
c. Section 2.931 Responsibilities
d. Section 2.938 Retention of records
e. Section 2.1072 Limitations on Supplier's Declaration of Conformity
f. Section 2.1074 Identification
g. Section 2.1077 Compliance Information

See Guidance on the use of SDoC in 896810 D01 SDoC v01r01 and 896810 D02 SDoC FAQ v01r02 .

As the EMC-Lab of SGS Germany GmbH is an FCC-recognized accredited testing laboratory, this test report can be used as basis for both procedures.

Based on **§15.3** the following description for locations and its emission classes is defined:

(h) **Class A digital device**. A digital device that is marketed for use in a commercial, industrial or business environment, exclusive of a device which is marketed for use by the general public or is intended to be used in the home.

(i) **Class B digital device**. A digital device that is marketed for use in a residential environment notwithstanding use in commercial, business and industrial environments. Examples of such devices include, but are not limited to, personal computers, calculators, and similar electronic devices that are marketed for use by the general public.

Based on **§15.105** the relevant **information to the limit class** has to be included in the manual.

Guidelines for **labeling and user information for RF** devices are contained in the following documents:

- 784748 D01 Labeling Part 15 18 Guidelines v09 provides general guidance for Part 15 and Part 18 labeling and user information.
- 748748 D02 e labeling v02 provides guidelines for displaying label information electronically (e-label).

2.4 Information concerning ICES Equipment Authorization

ITE is designated as Category II Equipment[4],meaning that no technical acceptability certificate (TAC) or equipment certification is required. ITE subject to ICES-003 is approved through the method of a “supplier’s declaration of conformity (SDoC)” by the manufacturer, importer or distributor of ITE, which shall ensure that compliance with all technical requirements prescribed by ICES-003 has been demonstrated and that the results have been compiled into a test report.

2.4.1 Labelling Requirements

The manufacturer, importer or supplier shall meet the labelling requirements set out in this section and in Notice 2014-DRS1003 for electronic labelling for every unit:
(i) prior to marketing in Canada, for ITE manufactured in Canada and
(ii) prior to importation into Canada, for imported ITE.
Each unit of an ITE model shall bear a label (see below) that represents the manufacturer’s or the importer’s SDoC with Innovation, Science and Economic Development Canada’s ICES-003. This label shall be permanently affixed to the ITE or displayed electronically and its text must be clearly legible. If the dimensions of the device are too small or if it is not practical to place the label on the ITE and electronic labelling has not been implemented, the label shall be, upon agreement with Innovation, Science and Economic Development Canada, placed in a prominent location in the user manual supplied with the ITE. The user manual may be in an electronic format and must be readily available.

Innovation, Science and Economic Development Canada ICES-003 Compliance Label:
CAN ICES-3 (*)/NMB-3(*)
* Insert either “A” or “B” but not both to identify the applicable Class of ITE.

[4] See Radiocommunication Regulations (SOR/96-484).

3 General Information

3.1 Identification of Client

Fazua GmbH
Testing Department
Marie-Curie-Straße 6
85521 Ottobrunn
Sascha Adler

3.2 Test Laboratory

SGS Germany GmbH
Hofmannstraße 50
81379 München

3.3 Time Schedule

Delivery of EUT: Dec 19, 2019
Start of test: Dec 19, 2019
End of test: Jul 14, 2020

3.4 Participants

Name	Function
Zoran Ratkovic	Accredited testing, Editor
Fath Allah Smaili	Accredited testing, Editor
Sascha Adler	Operating of EUT, Setup of EUT, Supervision of EUT-functionality

3.5 Environmental conditions

During the measurement, the environmental conditions were within the listed ranges:
Temperature: 20 - 26 °C
Humidity: 30 - 60 %

4 Equipment Under Test

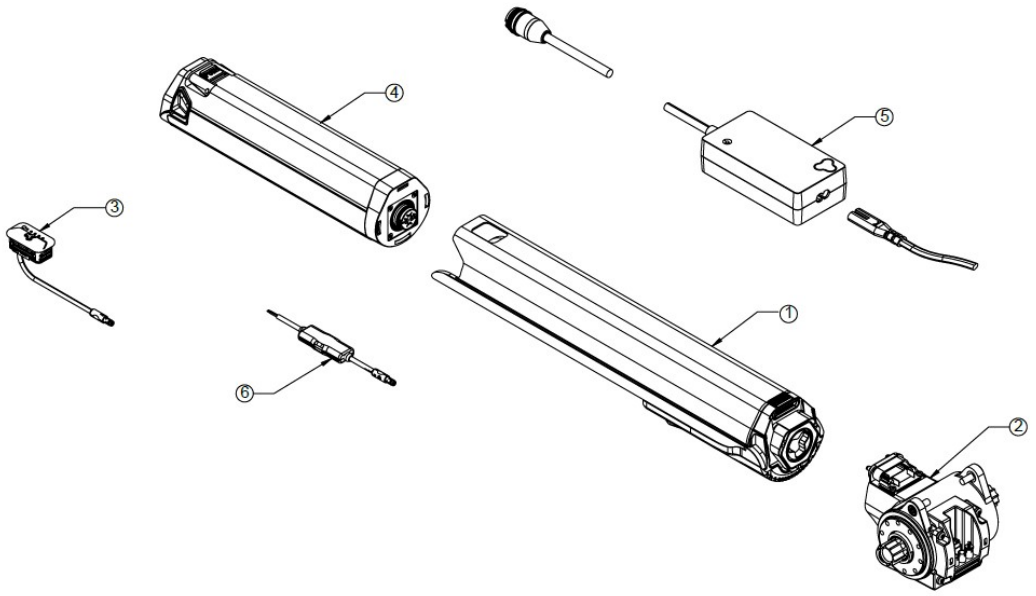
Test item description .....:	Drive system including motor and battery for Pedelec (EPAC)
Trademark..... .....:	**Evation**
Manufacturer / Importer .. ..:	Fazua GmbH
Model/Type ....:	evation Pedelec Drive Unit
Number of tested samples....:	One EPAC with integrated drive unit and battery
Serial Number(s) ....:	Representative test bike with
	Drivepack (motor unit), SN: 4211271017
	Bottom Bracket, SN: 1805072034
	Battery 250 X, SN: 4040000091
	Remote fX, SN: 4207113059
	Charger STC-8133LC-F, SN: KS-ST-201905-03653
	12V Connector Box, Pre-series E6 #8 from Q1 2019
Ratings (Charger)..... .....:	Input: 90 – 120V AC / 50 – 60 Hz / 90 W Output: 36V DC / 2 A

The evation Pedelec Drive Unit is an electric motor support system for Pedelecs (EPAC). It is designed for Pedelec 25 usage (limited to 25 km/h). The system has a modular design configuration to achieve a high level of integration into the bicycle frames, The power to weight ratio and user flexibility.

Evation is compatible with frame designs for mountain, road, gravel and city bikes and the system can be activated or deactivated according to the user's needs. The main components of the evation Pedelec Drive Units as shown in Figure 4-1 are as following:

1. evation DrivePack
2. evation Bottom Bracket
3. evationRemote fX
4. evation Battery 250 X (Capacity 250 Wh)
5. evation Charger US / CA
6. evation 12 V Connector Box (DC adapter) for Lighting

Note: Spider, cranks, and lights (front and rear) are not provided by Fazua and not part of the accessories either. The remote can be integrated into the top tube or in the down tube (therefor interface adapter 4a).



pos.	name	ID
1	evation Drivepack	5002000101
2	evation Bottom Bracket	5002000201
3	evation Remote fX	5002000301
4	evation Battery 250 X	5002000402
5	evation Charger US/CA	5002000502
6	evation 12V Connector Box	5002002401

Figure 4-1: Main components of evation Pedelec Drive Unit

Pedelec (EPAC) with evation Drive Unit

evation Remote fX (tested)

evation Battery 250 X (tested)

evation DrivePack or Motor Unit (tested)

evation Bottom Bracket (tested)

Figure 4-2: Main components of evation Pedelec Drive Unit with Remote, Battery, Drive-Pack and Bottom Bracket

US Charger STC-8133LC-F (tested)

Figure 4-3: Charger STC-8133LC-F (Serial production)

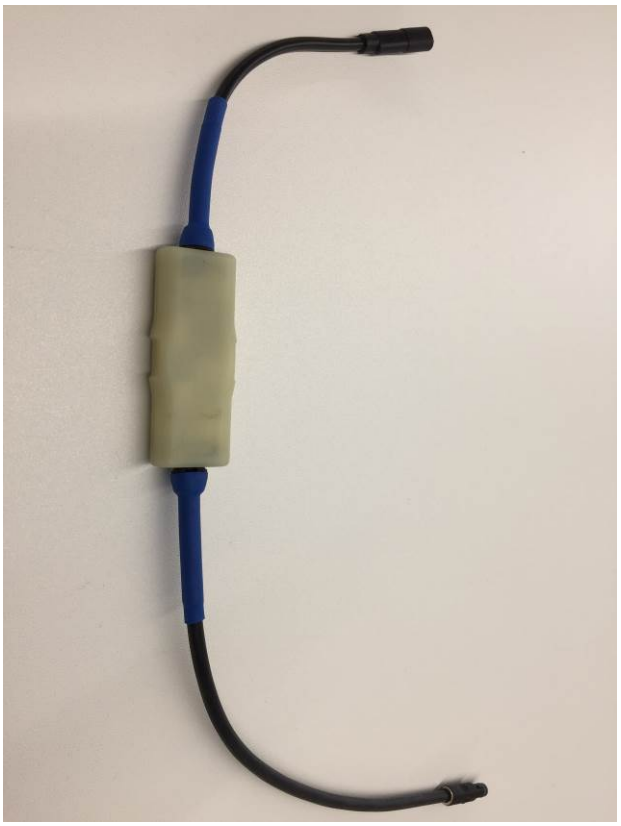
	
evation 12V Connector Box separately	evation 12 Connector Box installed in the EPAC

Figure 4-4: evation 12V Connector Box (for Lighting) used during test

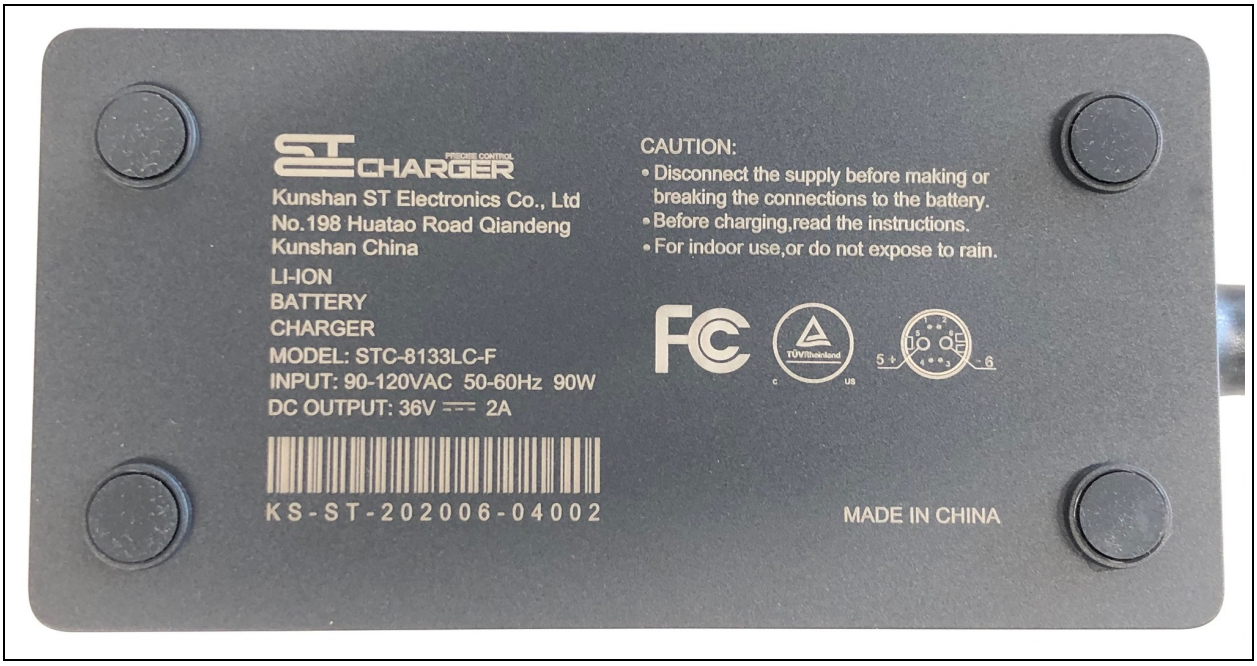


Figure 4-5: Copy of type plate of the charger STC-8133LC-F (Serial production)

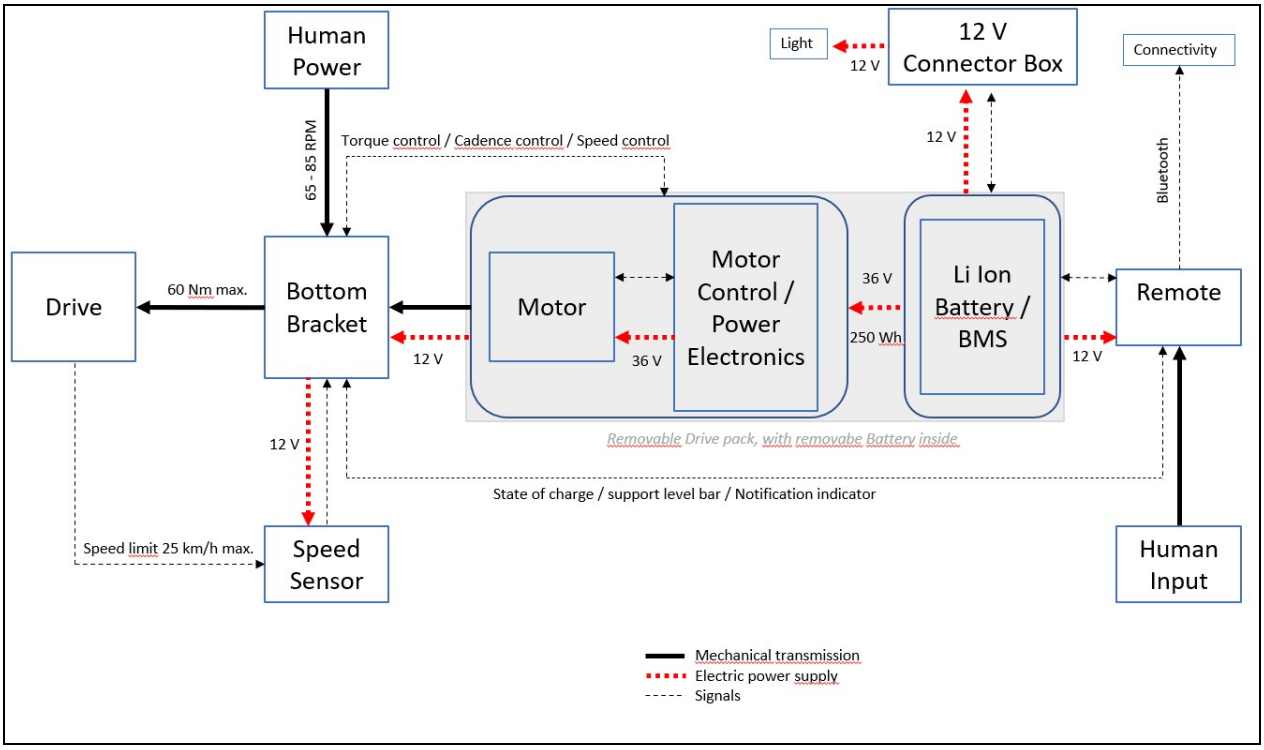


Figure 4-6: Block diagram of function for the evation Pedelec Drive Unit

4.1 Operational conditions

4.1.1 Software

Software necessary for operating, controlling and monitoring the EUT:

Name	Identification Code/Issue	Task
Evation Service tool box	Version: 1.14	Configuration, controls and monitoring of EUT parameters

4.1.2 Operation modes

☐ Normal operation

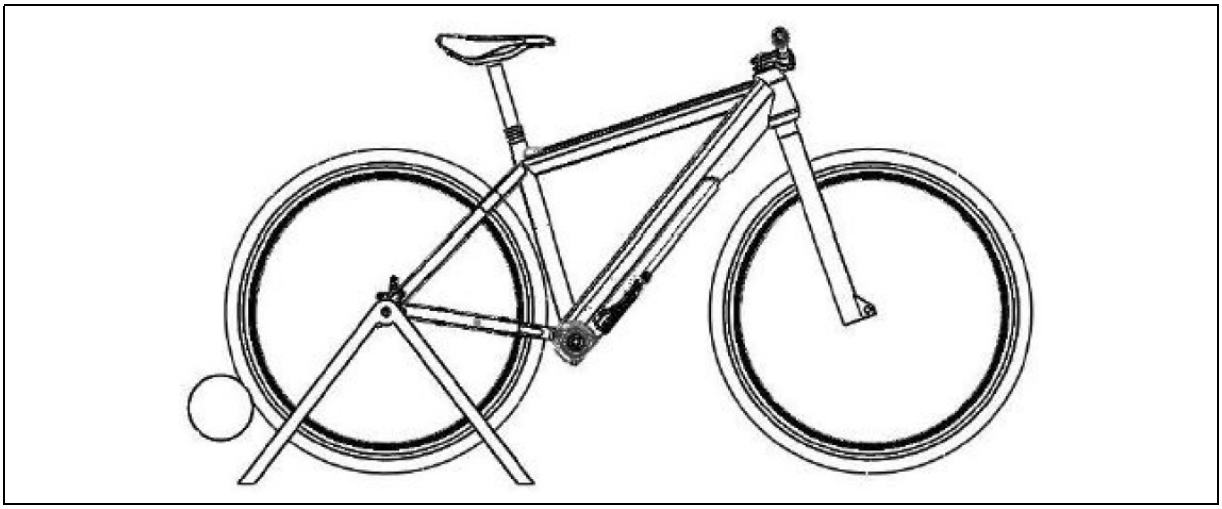
☒ Other operation:

The Operation mode on EPAC during the test is: Support Level 2

The EUT is also connected to Smartphone – with FAZUA evation app, Version 1.2.2, to check after each test procedure the functionality of the Bluetooth module. The Vehicle is in operation mode, support level 2.

4.1.3 Configuration mode 1

4.1.3.1 Configuration mode 1



Mode	180 W
Motor speed	2700 RPM
Motor torque	1,05 Nm
Gear (11-fold)	Gear 9
Speed (EPAC)	18 km/h (72 % speed)
Controlling of motor during testing	Computer via USB connection
Breaking device	Training bike stand (kinetic cyclone)

A requirement for the test is that the light on the bicycle remains switched on during the complete test procedure. This was guaranteed by the 12V Connector Box (DC adapter) used.
This function is ensured by the light module integrated with the bicycle as shown in Figure 4-6: Block diagram of function.

4.1.3.2 Configuration mode 2

Battery on charge

4.2 Hardware Configuration

4.2.1 Components of the EUT

Name	Identification Code/Issue/Serial Number	Interface type	Quantity
Bike	Representative test bike		1
evation Drivepack	AN: 5002000101 SN: 4211271017	Rosenberger connector type B001-12-XXX-C	1
evation Bottom Bracket	AN: 5002000201 SN: 1805072034	screwed to the bicycle frame	1
evation Battery 250 X	AN: 5002000402 SN: 4040000091	integrated in the DrivePack, Rosenberger connector type Discharge C003-G3_300-C Charge B001-28-65-C	1
evation Remote fX	AN: 5002000301 SN: 4207113059	integrated in the frame, connected to bottom bracket via electrical plug connection	1
evation 12V Connector Box	AN: 5002002401 SN: E6 #8	integrated in the frame, connected to bottom bracket via electrical plug connection and connected to lighting	1
Charger	Model/TYp: STC-8133LC-F SN: KS-ST-201905-03653	Rosenberger connector type C003-03-XXX-Y	1

4.2.2 Interface description

All interfaces are identified independent whether they are tested or not.

4.2.2.1 Power supply port

Type (AC/DC)	Voltage	Frequency	Current	Power	Comment
AC (Charger)	90 - 120V	60 Hz			External Power supply for the charger
DC	12V	-	2 A	24 W	Internal Power supply from Battery to Remote and to Lighting Module
DC	36 V		15 A	540 W	Internal Power supply from Battery to Motor drive

4.2.2.2 Earthing and Grounding connections [5]

Type	Task	Connected to	Test E/I/NA
None			

5 Safety ground, functional earth, specific ground connections

4.2.2.3 Communication [6] and signal [7] ports

Type	Bit rate/frequency/ Signal	Task	Connected to
CAN	250 kHz	Communication	To the main drive system controller for communication between Remote, Battery, Drivepack (motor unit) and 12 V box
I2C	100 kHz	Communication	For processing the information from the bottom bracket, e.g. torque, speed, in the main drive system controller
USB	250 kHz	Communication	To Fazua Service Toolbox, for update a new Software revision or configuration, controls and monitoring of drive system parameters

4.2.3 Cabling

Name	Identification Code/Issue/ Serial Number	shield	Description of Connection / plug type	length	Quantity
USB A to mini USB B	AWM Style 2725 VW-1	no	Configuration, controls and monitoring of EUT parameters	< 3m	1

6 Connections to communication networks, Analog, Ethernet, Antenna, Wireless, GPS,

7 Signalling, monitoring, and control ports

4.2.4 Clock frequencies of the EUT resulting in determination of frequency range

System / Subsystem	Clock Freqency for Operation*	Comment
12 V CONNECTOR BOX	**32 MHz** (MCU) **8 MHz** (CAN controller)	
BATTERY 250 X (Battery pack)	**40 MHz** (MCU) **32.768 kHz** (low frequency clock)	8 MHz (MCU) x 5
DRIVEPACK (Motor unit)	**48 MHz** (MCU) **8 MHz** (CAN controller) **250 MHz** (xCORE motor control chip) **32.768 kHz** (low frequency clock)	250 kHz for CAN-Bus communication
REMOTE fX	**32 MHz** (MCU) **8 MHz** (CAN controller)	The integrated Bluetooth module chip is also operated with 32 MHz.
BOTTOM BRACKET	**72 MHz** (MCU)	8 MHz (MCU) x 9
CAN-Bus Communication	**250 kHz**	For communication between Remote fX, Battery 250 X, Drivepack and 12 V Connector Box.
I2C-Bus Communication	**100 kHz**	For processing the information from the Bottom Bracket, e.g. torque, speed, in the main drive system controller in the Drivepack.
Communication via USB	**12 MHz**	For USB 2.0 full speed to FAZUA Service Toolbox, for update a new Software revision or configuration, controls and monitoring of drive system parameters by end customers.

System / Subsystem	Highest clock frequency	Comment
Bluetooth module	2.4 GHz	Bluetooth module provide communication with external device like smartphone. Module is certified with FCC ID RYYEYSGJN

The result of the table above with the highest frequency of the internal source is basis of the determination of the necessity of measurement above 1 GHz. The highest internal source of a EUT is defined as the highest frequency generated or used within the EUT or on which the EUT operates or tunes.
See **FCC §15.33 a)** for relevant frequency range of **intentional radiators**.
See **FCC §15.33 b)** for relevant frequency range of **unintentional radiators**.

See e.g. the following table taken from FCC §15.33 b) 1)

Highest frequency generated or used in the device or on which the device operates or tunes (MHz)	**Upper frequency of measurement range (MHz)**
Below 1.705	30
1.705-108	1000
108-500	2000
500-1000	5000
Above 1000	5th harmonic of the highest frequency or 40 GHz, whichever is lower

4.2.5 External protection devices or measures

EMC relevant external protection devices or measures, are specified in the user's manual (e.g. overvoltage, shielding, bonding and grounding).

None

4.2.6 Modifications during the test

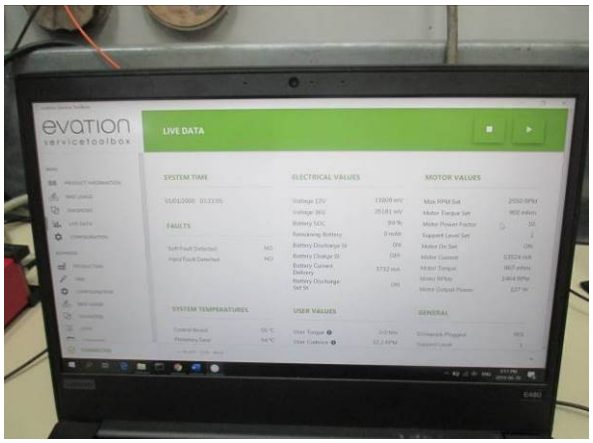
Würth Ferrite 742 758 12 has been applied along the lighting cable, which is not part of EUT. It is internal cable of the bike used as testing accessory

Würth Ferrite 742 717 33 (2x) has been applied along the USB cable for Data transfer. The USB cable is not part of EUT and not be delivered by manufacturer

4.2.7 Operation and monitoring equipment

Name / Identification	Task	Availability [8] C/L
evation Service Toolbox	Configuration, controls and monitoring of the driven motor parameters	C

Evation service toolbox and monitoring are not part of the EUT and delivered only for testing purpose.



4.3 Deviations from Standard

None

[8] C: Provided by the customer, L: Available at laboratory

5 Test Equipment

5.1 Test Facility

The EMC-tests are carried out in the EMC-laboratory of SGS Germany, Consumer and Retail, Hofmannstraße 50, 81379 München, Germany.

Chamber	1	2	3	4 / 5	6
Dimensions (net)	17.7 * 10.8 * 6.8 m	9.6 * 8.5 * 5.3 m	7.4 * 6.6 * 5.2 m	4.1 * 3.5 * 3.5m	6.4 * 4.3 * 4.3m
Max. Door Exit (w x h)	2.9 * 3.86 m	3.9 * 4.0 m	2.0 * 2.7 m	0.9 * 2.25 m	1.8 * 3.0 m
Shielding material	Sheet steel (Thick-ness:1.5mm on floor, 1.0 mm on walls and ceiling)	Sheet steel	Sheet steel	Sheet steel	Sheet steel
Absorbers	Hybrid absorbers on walls and ceiling (TDK), length 1 m	Hybrid absorbers on walls and ceiling (E+C), length 0.5 m	Hybrid absorbers on walls and ceiling (E+C), length 0.3 m	Without ab-sorbers	Without ab-sorbers
Floor	Metallic ground plane floor load: 12 t/m²	Metallic ground plane floor load: 1.5 t/m²	Metallic ground plane floor load: 1 t/m²	Metallic ground plane	Metallic ground plane
Turntable	∅ 4 m / 7 t	∅ 3.2 m / 1.5 t	∅ 2.0 m / 1 t		
Listings		VCCI-listed until Oct. 2019, Reg. No. R-2623, G-266			VCCI-listed until Oct. 2019, Reg. No. C-2866 & No. T-1942
Specials	***Emission*:** ***30 – 1000 MHz (d = 10 m)*** - NSA acc. to: ・ CISPR 16-1-4 ・ ANSI C63.4 ***1 – 18 GHz (d = 3 m)*** Site VSWR 1 – 18 GHz acc. to CISPR 16-1-4	***Emission*:** ***30 – 1000 MHz (d = 3 m)*** - NSA acc. to: ・ CISPR 16-1-4 ・ ANSI C63.4 ***1 – 18 GHz (d = 3 m)*** Site VSWR 1 – 18 GHz acc. to CISPR 16-1-4	***Emission*:** ***30 – 1000 MHz (d = 3 m)*** - NSA acc. to: ・ CISPR 16-1-4 ・ ANSI C63.4 ***1 – 18 GHz (d = 3 m)*** Site VSWR 1 – 18 GHz acc. to CISPR 16-1-4		
	Immunity: Field uniformity 27 – 6000 MHz acc. IEC/EN 61000-4-3	***Immunity:*** Field uniformity 80 – 6000 MHz acc. IEC/EN 61000-4-3	***Immunity:*** Field uniformity 80 – 6000 MHz acc. IEC/EN 61000-4-3		

FCC (Federal Communication Commission): Recognition by Bundesnetzagentur (BNetzA-CAB-14/21-09) and Designation as **CAB (Conformity Assessment Body):** Designation Number DE0013; Test firm Registration #: 366296
Designation **KBA** (**Kraftfahrt-Bundesamt**) as Technical Service category A and D. Registration Number: KBA-P 00083-97
CB Testing Laboratory under the responsibility of SGS CEBEC as National Certification Body and to carry out testing within the **IECEE CB Scheme.**
Designation No. for **RRA** (Radio Research Agency) in **Korea; EU0145**

5.2 Measurement Uncertainty

As far as the underlying standards include requirements concerning the uncertainty of measuring instruments or measuring methods, they are met.
The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities.

The expanded measurement uncertainty of the measuring chain was calculated for all tests according to the “ISO Guide to the expression of uncertainty in measurement (GUM)”. The results are documented in an “internal controlled document”.

The measuring accuracy for all measuring devices is given in their technical description. The measuring instruments, including any accessories, are calibrated respectively verified to ensure the necessary accuracy. Depending on the kind of measuring equipment it is checked within regular intervals or directly before the measurement is performed. Adjustments are made and correction factors applied to measured data in accordance with the specifications of the specific instrument.

The expanded measurement instrumentation uncertainty of our Test Laboratory meets the requirements of IEC CISPR 16-4-2 “Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainties, statistics and limit modeling – Measurement instrumentation uncertainty” and the relevant basic standards for all listed Tests.

6 Test Conditions and Results

6.1 Conducted disturbance, 120V, 60Hz (150 kHz to 30 MHz)

Phenomena	Reference	Frequency Range	Criteria	Verdict [1]
Conducted Emission AC Power Ports	FCC 47 CFR Part 15 §15.107	150 kHz – 30 MHz	Class B	P
Conducted Emission AC Power Ports	ICES-003	150 kHz – 30 MHz	Class B	P

(The conducted emission limits of FCC 47 CFR Part 15 §15.107 Class A/B are identical with ICES-003 class A/B.)

Tested by : Smaili

Test date : 2019-12-19 Test location : EMC chamber No. 4

Test procedure

Measured levels of power-line conducted emission are the radio-noise voltage levels across the 50 Ω LISN port (to which the EUT is connected) terminated into a 50 Ω EMI receiver. All radio-noise voltage measurements are made on each current carrying conductor at the plug end of the EUT power cord. The measurement is performed using a receiver with peak and average detector.
Only if the measured peak value is near or above the quasi-peak limit the detector function is changed to quasi-peak for final measurement of the highest voltage levels.

Exploratory emission measurements are to be performed considering operation states and cable arrangement to evaluate configuration with highest emission levels (C63.4-2014, Clause 7.3.3 and 7.3.4).

Acc. ANSI C63.4 chapter 10.2.8.3: AC power-line conducted emissions measurements are to be separately carried out only on each of the phase ("hot") line(s) and (if used) on the neutral line(s), but not on the ground [protective earth) line(s).
Table-top equipment is arranged 80 cm above ground plane.

EMC-Test-SW: EMC32 version 10.50.40 (R&S)

Sample Calculation with all conversion and correction factors used:
$\sum CF = CF_{Cables} + CF_{LISN}$

Test location: EMC-chamber No. 4

Instruments and accessories

ID	Description	Manufacturer	Model	Serial No.	Status	Cal. date	Cal. due
P0339	test chamber 4	Siemens			chk	Feb 22, 2019	Feb 2020
P0441	LISN (integrated pulse limiter P0488)	R&S	ESH3-Z5	894498/004	cal	Apr 02, 2019	Apr 2021
P2076	Power Supply	PCE Power Control GmbH & Co. KG	Chroma 61605, AC-/DC Source	616050001644	ind		
P1891	RF-Relais-Matrix	R&S	PSU	872584/018	cnn		
P0320	EMI receiver, MZ4	R&S	ESCS30	100099	cal	Apr 05, 2018	Apr 2020
P1325	EMI receiver	R&S	ESPI-3	101500	cal	Apr 08, 2019	Apr 2021

cal = Calibration, car = Calibration restricted use, chk = Check, chr = Check restricted use, cpu = Check prior to use, calchk = Calibration and check, ind = for indication only, cnn = Calibration not necessary, man = Maintenance

Photo documentation of the test set-up:

Figure 6-1: test setup Low voltage AC mains continuous disturbance

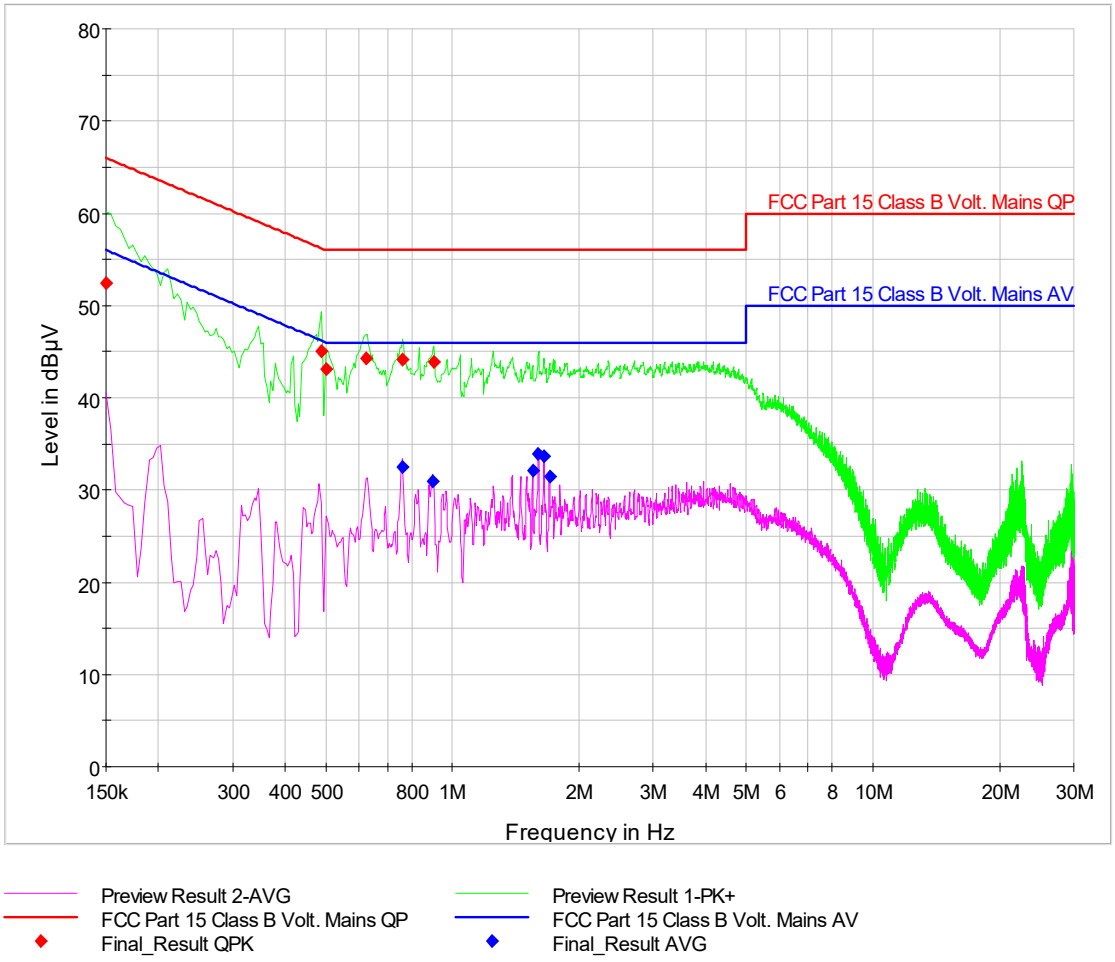


Figure 6-2: Graphical presentation Low voltage AC mains continuous disturbance, Neutral line

Result table:

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.150000	52.40	---	66.00	13.60	1000.0	9.000	N	FLO	10
0.486000	45.01	---	56.24	11.22	1000.0	9.000	N	FLO	10
0.502000	43.06	---	56.00	12.94	1000.0	9.000	N	FLO	10
0.622000	44.25	---	56.00	11.75	1000.0	9.000	N	FLO	10
0.758000	---	32.47	46.00	13.53	1000.0	9.000	N	FLO	10
0.762000	44.17	---	56.00	11.83	1000.0	9.000	N	FLO	10
0.898000	---	30.96	46.00	15.04	1000.0	9.000	N	FLO	10
0.902000	43.83	---	56.00	12.17	1000.0	9.000	N	FLO	10
1.550000	---	32.08	46.00	13.92	1000.0	9.000	N	FLO	10
1.598000	---	33.86	46.00	12.14	1000.0	9.000	N	FLO	10
1.650000	---	33.68	46.00	12.32	1000.0	9.000	N	FLO	10
1.702000	---	31.40	46.00	14.60	1000.0	9.000	N	FLO	10

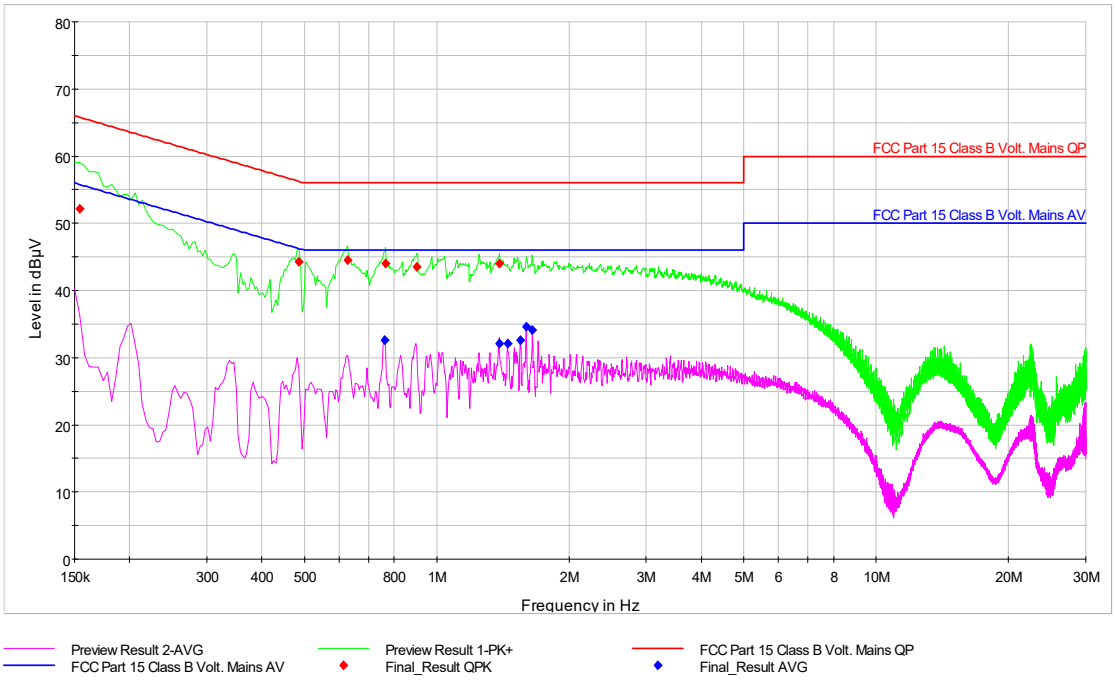


Figure 6-3: Graphical presentation Low voltage AC mains continuous disturbance, Phase

Result table:

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.154000	52.17	---	65.78	13.61	1000.0	9.000	L1	FLO	10
0.486000	44.29	---	56.24	11.94	1000.0	9.000	L1	FLO	10
0.626000	44.55	---	56.00	11.45	1000.0	9.000	L1	FLO	10
0.762000	---	32.55	46.00	13.45	1000.0	9.000	L1	FLO	10
0.766000	44.01	---	56.00	11.99	1000.0	9.000	L1	FLO	10
0.902000	43.55	---	56.00	12.45	1000.0	9.000	L1	FLO	10
1.386000	---	32.08	46.00	13.92	1000.0	9.000	L1	FLO	10
1.390000	44.06	---	56.00	11.94	1000.0	9.000	L1	FLO	10
1.450000	---	32.06	46.00	13.94	1000.0	9.000	L1	FLO	10
1.550000	---	32.66	46.00	13.34	1000.0	9.000	L1	FLO	10
1.598000	---	34.66	46.00	11.34	1000.0	9.000	L1	FLO	10
1.650000	---	34.14	46.00	11.86	1000.0	9.000	L1	FLO	10

6.2 Radiated disturbances (30 MHz to 1000 MHz)

Phenomena	Reference	Frequency Range	Criteria	Verdict [1]
Radio Disturbance Electric Field	FCC 47 CFR Part 15 §15.109	30 MHz - 1 GHz distance 3 m	Class B	P
Radio Disturbance Electric Field	ICES-003	30 MHz - 1 GHz distance 3 m	Class B	P

(The radiated emission limits < 1 GHz of FCC 47 CFR Part 15 §15.109 Class A/B are identical with ICES-003 class A/B.)

Test procedure:

Radiated measurements are performed in a semi-anechoic chamber meeting the normalized site attenuation of ANSI C63.4 and listed with the FCC. The applicable frequency spectrum is scanned with a calibrated RF measuring system using an appropriate broadband antenna and an EMI-receiver/spectrum analyzer and compared to the required limits. The measuring instrument performs the field strength calculations automatically. The measuring software provides resident AF and CF figures for individual antennas and cables. The receiver/analyzer is set to "peak" mode from 30 MHz to 1 GHz. On any emission of concern, the receiver is set to quasi-peak mode.

“Maximization” of each suspect frequency is accomplished by a combination of a 360° azimuth search using a turntable and varying the antenna to ground plane height from 1 m to 4 m. Also, both the vertical and horizontal polarization is scanned in the required frequency range per ANSI C63.4.
Maximization of emission results starts at 0° of the turn table with antenna in horizontal polarization is set to 1 m. While the turntable slowly moves to 360°, the spectrum analyzer is sweeping from 30 to 1000 MHz and maximum data is recorded. Antenna is set to 2 m and turntable slowly moves back to 0° while the spectrum analyzer is sweeping again. This is repeated until the antenna height of 4 m is reached.
The antenna polarization is set to vertical and the procedure described above is repeated.
For each frequency, the measuring software stores the maximum level as well as the corresponding settings of turntable and antenna. An azimuth resolution of about 3° is realized using this method.
At least the six highest frequencies are selected automatically by the software for performing the final measurements.
At each of these frequencies the turntable as well as the antenna is set to the corresponding settings. Then the antenna is slowly moved 50 cm down/up related to initial position while the receiver is measuring at this frequency. The highest emission level and the corresponding height are recorded. At this final position, the measurement is performed with quasi-peak detector. Exploratory emission measurements are to be performed considering operation states and cable arrangement to evaluate configuration with highest emission levels (C63.4, Clause 8.3.1 and 8.3.2).
Table-top equipment is arranged 80 cm above ground plane.

Test location: semi anechoic chamber No. 3

EMC-Test-SW: EMC32 version 10.50.40 (R&S)

Sample Calculation with all conversion and correction factors used:

$\sum CF = CF_{Cables} + CF_{Antenna}$

Instruments and accessories

ID	Description	Manufacturer	Model	Serial No.	Status	Cal. date	Cal. due
P1326	EMI receiver	R&S	ESU26	100058	cal	Apr 05, 2018	Apr 2020
P1299	video camera MZ3	Pontis		6410703001	ind		
P1303	Mast (MZ3)	innco GmbH	MA 4660-XPET		cnn		
P1304	Controller	innco GmbH	CO 3000	CO3000/915	cnn		
P0014	antenna	Chase	CBL6111	1140	cal	Apr 26, 2019	Apr 2022
P2472	Digital Optical Transmitter f. USB Signals	mk Messtechnik (EMCO)	optoUSB2.0 + BP-84	19-016426+19-016427+19-016354	cnn		
P1914	Data logger for humidity and temperature (MZ3)	testo AG	testo 175 H1	40342576	cal	Aug 19, 2017	Aug 2020
P0338	test chamber 3	Siemens			chk	Feb 22, 2019	Feb 2020

cal = Calibration, car = Calibration restricted use, chk = Check, chr = Check restricted use, cpu = Check prior to use, calchk = Calibration and check, ind = for indication only, cnn = Calibration not necessary, man = Maintenance

6.2.1 Configuration Mode 1

Tested by : Z. Ratkovic

Test date : 2019-12-19 Test location : EMC chamber No. 3

Specific EUT conditions during test:

Bluetooth communication with Smartphone. (WiFi and Carrier also on)

Photo documentation of the test set-up:

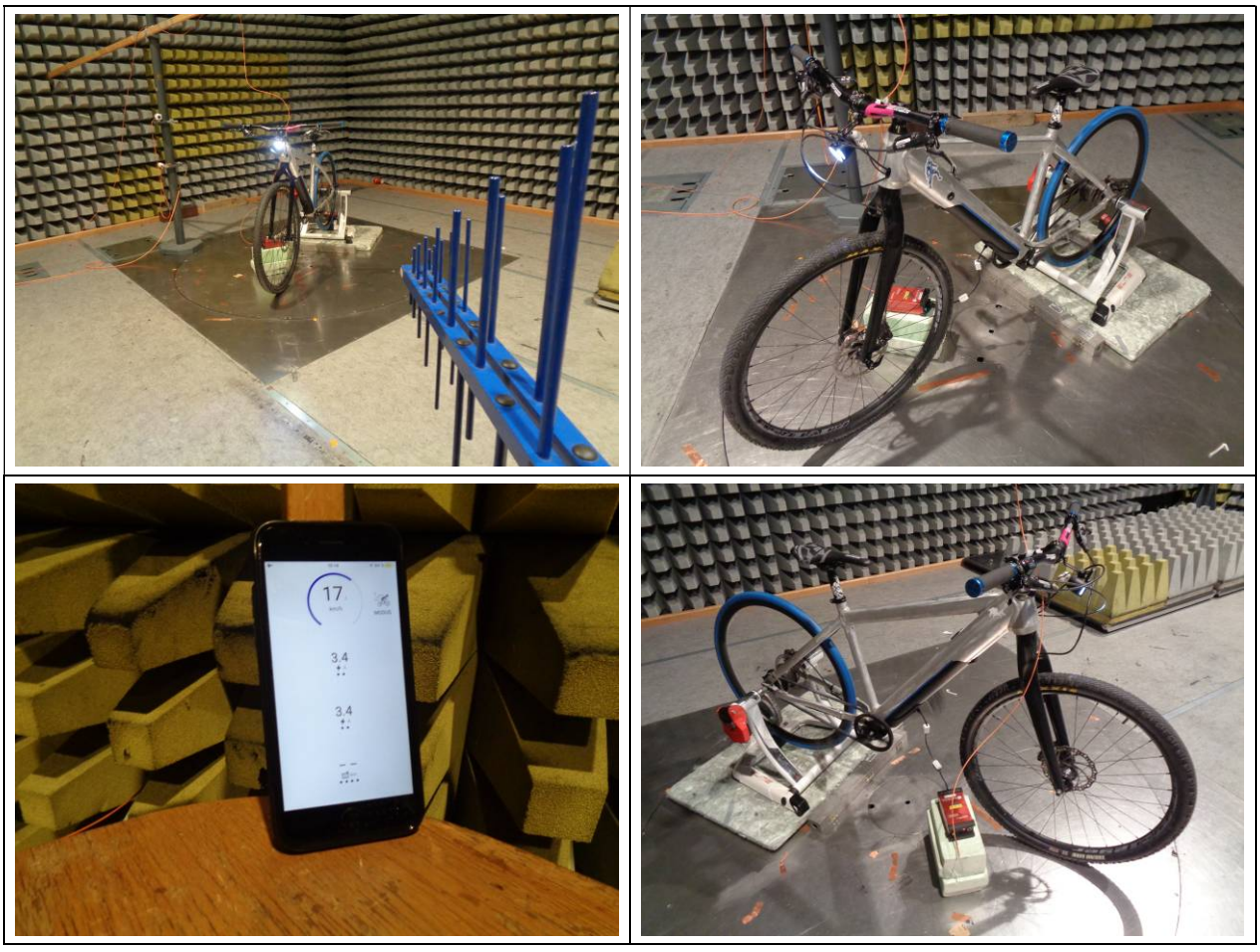


Figure 6-4: test setup for Radiated disturbances 30 MHz to 1000 MHz – Configuration mode 1

Result:

verdict:	**pass**

For detailed results, please see below.

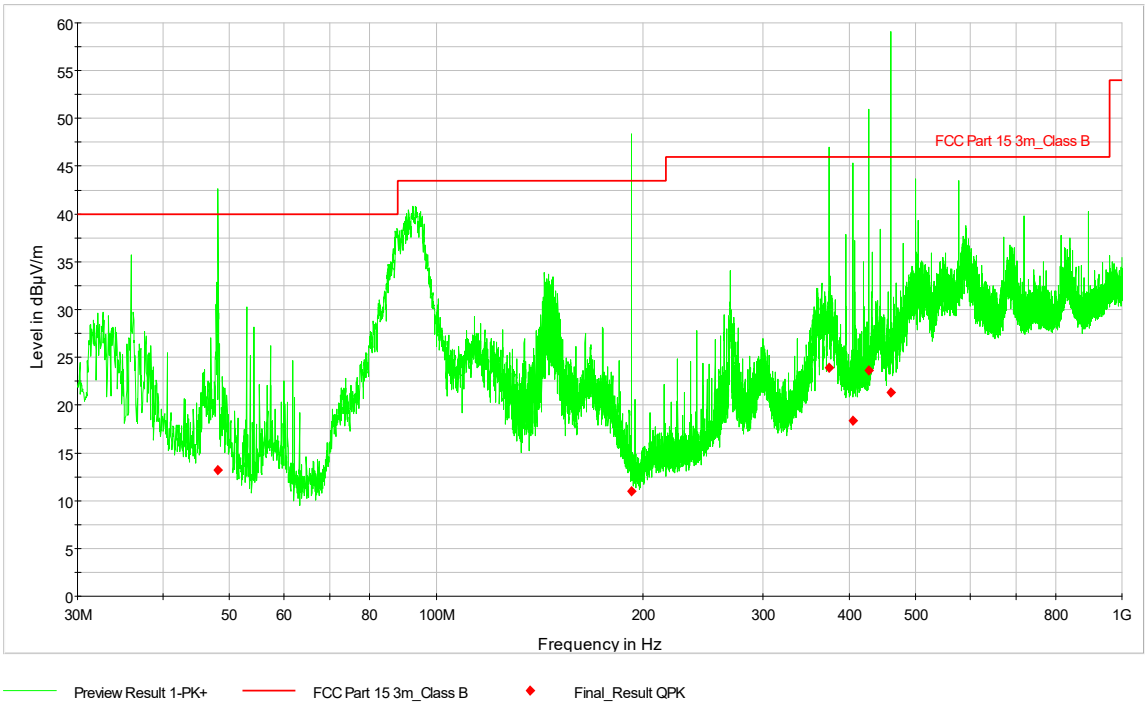


Figure 6-5: Graphical presentation Radiated disturbances 30 MHz to 1000 MHz

Result table:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
48.090500	13.18	40.00	26.82	15000.0	120.000	166.0	H	161.0	10
192.766000	10.98	43.50	32.52	15000.0	120.000	173.0	H	0.0	10
374.592500	23.95	46.00	22.05	15000.0	120.000	244.0	H	89.0	16
404.808000	18.33	46.00	27.67	15000.0	120.000	255.0	H	304.0	18
427.603000	23.64	46.00	22.36	15000.0	120.000	124.0	V	257.0	18
460.437500	21.37	46.00	24.64	15000.0	120.000	189.0	H	115.0	19

6.2.2 Configuration Mode 2

Tested by : Smaili

Test date : 2020-07-14 Test location : EMC chamber No. 3

Specific EUT conditions during test:

Bluetooth communication with Smartphone. (WiFi and Carrier also on)

Photo documentation of the test set-up:

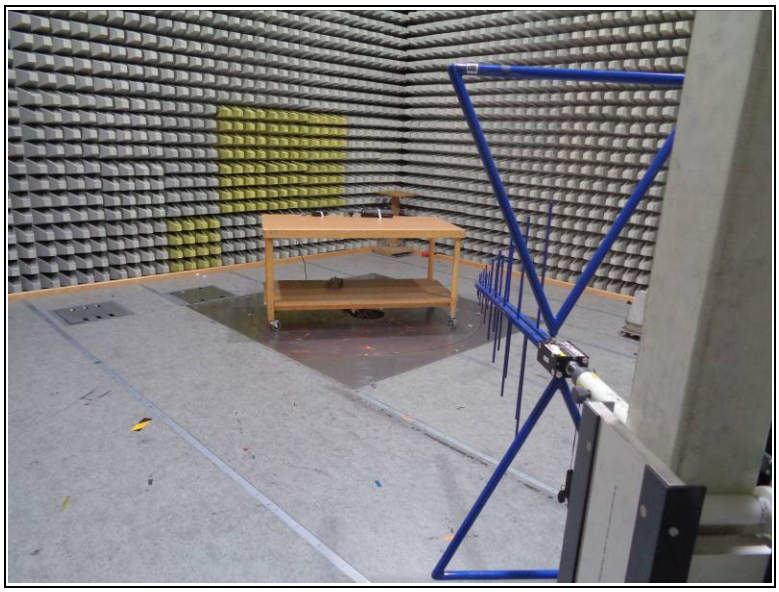


Figure 6-6: test setup for Radiated disturbances 30 MHz to 1000 MHz – Configuration mode 2

Result:

verdict:	**pass**

For detailed results, please see below.

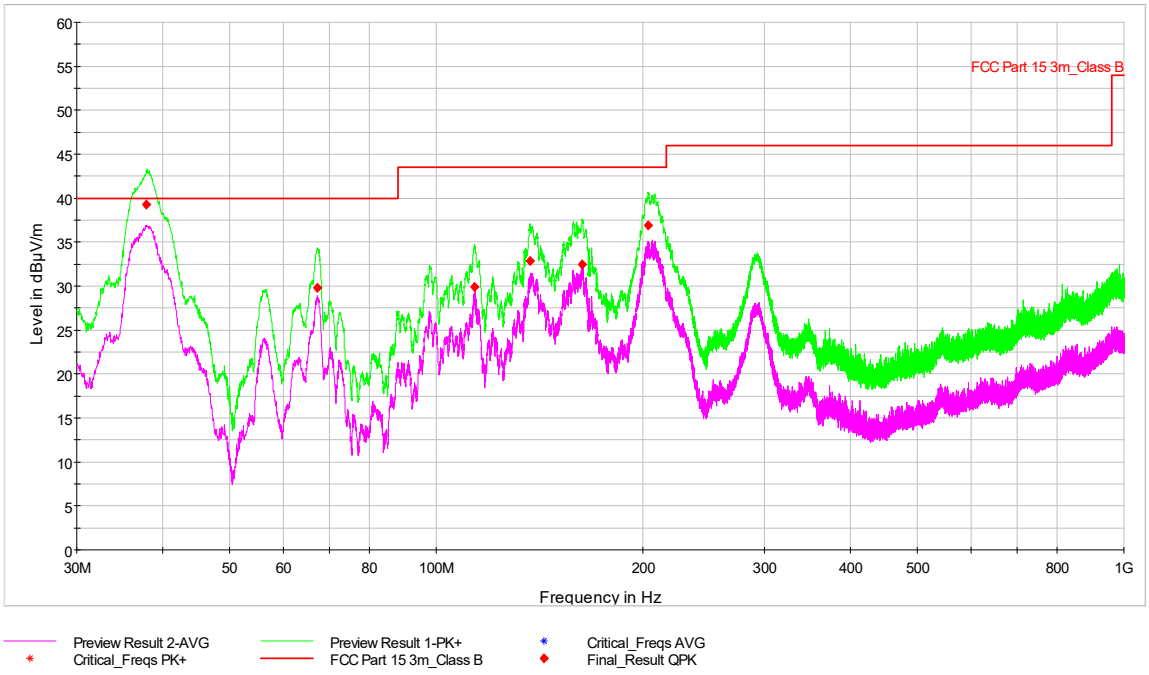


Figure 6-7: Graphical presentation Radiated disturbances 30 MHz to 1000 MHz

Result table:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
37.822500	39.30	40.00	0.70	15000.0	120.000	100.0	V	7.0	15
67.091000	29.79	40.00	10.21	15000.0	120.000	226.0	H	5.0	6
113.762500	29.88	43.50	13.62	15000.0	120.000	110.0	V	281.0	12
136.680000	32.83	43.50	10.67	15000.0	120.000	104.0	V	241.0	12
163.007000	32.44	43.50	11.06	15000.0	120.000	164.0	H	5.0	11
203.407500	36.96	43.50	6.54	15000.0	120.000	100.0	V	0.0	10

6.3 Radiated disturbances (1 GHz to 26 GHz)

Phenomena	Reference	Frequency Range	Criteria	Verdict [1]
Radio Disturbance Electric Field	FCC 47 CFR Part 15 §15.109	1 GHz - 26 GHz Distance 3 m	Class B	P
Radio Disturbance Electric Field	ICES-003	1 GHz - 26 GHz Distance 3 m	Class B	P

(The radiated emission limits > 1 GHz for AV-detector of FCC 47 CFR Part 15 §15.109 Class A/B are identical with ICES-003 class A/B. In addition, ICES-003 requires also a peak-limit with 20 dB above relevant AV-limit.)

Tested by : Z. Ratkovic

Test date : 2019-12-19 Test location : EMC chamber No. 3

Test Execution

Radiated measurements are performed in a semi-anechoic chamber meeting the normalized site attenuation of ANSI C63.4 as well as the Site VSWR requirements of CISPR16 and listed with the FCC. The applicable frequency spectrum is scanned with a calibrated RF measuring system using an appropriate broadband antenna and an EMI-receiver/spectrum analyzer and compared to the required limits. The measuring instrument performs the field strength calculations automatically. The measuring software provides resident AF and CF figures for individual antennas and cables. The receiver/analyzer is set to "peak" mode in the relevant frequency range. On any emission of concern, the receiver is set to average mode.

For EUTs having a size larger than the beamwidth of the antenna, appropriate countermeasures shall be taken, e.g. increasing the measuring distance or different antenna positions (lateral) to scan the complete surface of EUT.
"Maximization" of each suspect frequency is accomplished by a combination of a 360° azimuth search using a turntable and varying the antenna to ground plane height from 1 m to 4 m. Both, the vertical and horizontal polarization is scanned in the required frequency range per ANSI C63.4.
Maximization of emission results starts at 0° of the turn table with antenna in horizontal polarization is set to 1 m. While the turntable slowly moves to 360°, the spectrum analyzer is sweeping from 1 to 26 GHz and maximum data is recorded. Antenna is set to 1.5 m and turntable slowly moves back to 0° while the spectrum analyzer is sweeping again. This is repeated until the antenna height of 4 m is reached (step: 0.5m).
The antenna polarization is set to vertical and the procedure described above is repeated.
For each frequency, the measuring software stores the maximum level as well as the corresponding settings of turntable and antenna. An azimuth resolution of about 3° is realized using this method.
At least the six highest frequencies are selected automatically by the software for performing the final measurements. At each of these frequencies the turntable as well as the antenna is set to the corresponding settings. Then the antenna is slowly moved 25 cm down/up related to initial position while the receiver is measuring at this frequency. The highest emission level and the corresponding height are recorded. At this final position, the measurement is performed with average detector.
Exploratory emission measurements are to be performed considering operation states and cable arrangement to evaluate configuration with highest emission levels (C63.4, Clause 8.3.1 and 8.3.2).

Final measurements were performed acc C63.4, clause 8.3.2.2 aimed at the emission source for receiving the maximum signal.
Table-top equipment is arranged 80 cm above ground plane.

Test location: semi anechoic chamber No. 3

EMC-Test-SW: EMC32 version 10.50.40 (R&S)

Sample Calculation with all conversion and correction factors used:
$\sum CF = CF_{Cables} + CF_{Antenna} + CF_{Preamplifier}$

Specific EUT conditions during test:

Bluetooth communication with Smartphone. (WiFi and Carrier also on)

6.3.1 Radiated disturbances (1 GHz to 18 GHz)

Instruments and accessories

ID	Description	Manufacturer	Model	Serial No.	Status	Cal. date	Cal. due
P1326	EMI receiver	R&S	ESU26	100058	cal	Apr 05, 2018	Apr 2020
P1299	video camera MZ3	Pontis		6410703001	ind		
P1303	Mast (MZ3)	innco GmbH	MA 4660-XPET		cnn		
P1304	Controller	innco GmbH	CO 3000	CO3000/915	cnn		
P0030	antenna (MZ3)	EATON	96001	2622	cal	Apr 11, 2018	Apr 2020
P1650	preamplifier (MZ3)	Kuhne electronic	KU LNA BB 202 A		cal	Apr 10, 2019	Apr 2021
P1907	coax cable 5m	Suhner	Sucoflex 104A	503239/4A	chk	Feb 20, 2019	Feb 2020
P2472	Digital Optical Transmitter f. USB Signals	mk Messtechnik (EMCO)	optoUSB2.0 + BP-84	19-016426+19-016427+19-016354	cnn		
P1914	Data logger for humidity and temperature (MZ3)	testo AG	testo 175 H1	40342576	cal	Aug 19, 2017	Aug 2020
P0338	test chamber 3	Siemens			chk	Feb 22, 2019	Feb 2020

cal = Calibration, car = Calibration restricted use, chk = Check, chr = Check restricted use, cpu = Check prior to use, calchk = Calibration and check, ind = for indication only, cnn = Calibration not necessary, man = Maintenance

Photo documentation of the test set-up:

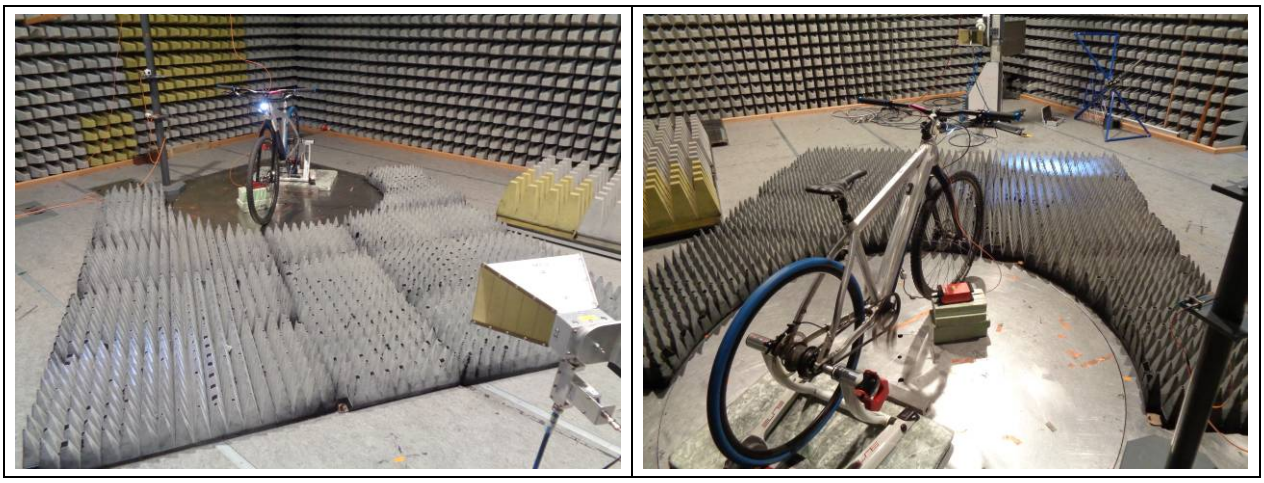


Figure 6-8: test setup for radiated disturbances 1 GHz to 18 GHz

Result:

verdict:	**pass**

For detailed results, please see below.

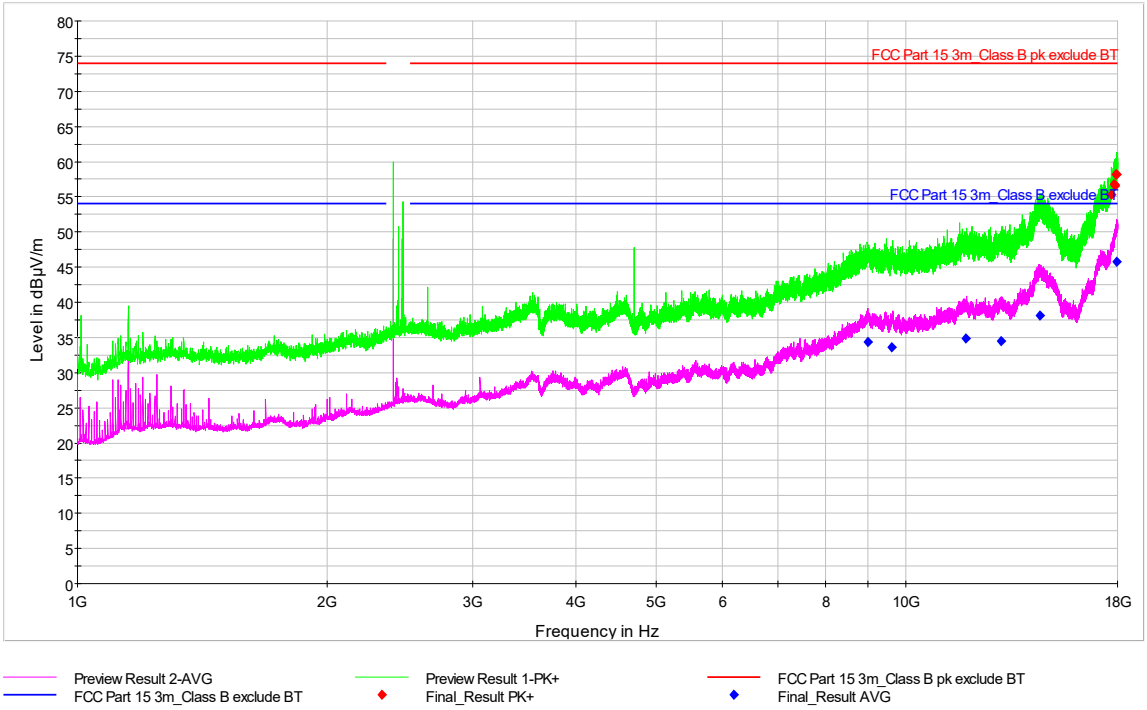


Figure 6-9: Graphical presentation Radiated disturbances 1 GHz to 18 GHz

Result table:

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
8997.000000	---	34.33	54.00	19.67	1000.0	1000.000	150.0	V	285.0	23
9615.766667	---	33.63	54.00	20.37	1000.0	1000.000	322.0	V	349.0	23
11812.800000	---	34.80	54.00	19.20	1000.0	1000.000	100.0	V	0.0	25
13014.033333	---	34.44	54.00	19.56	1000.0	1000.000	146.0	V	322.0	26
14493.600000	---	38.18	54.00	15.82	1000.0	1000.000	250.0	V	32.0	31
17715.400000	55.31	---	74.00	18.69	1000.0	1000.000	345.0	V	328.0	34
17839.300000	56.81	---	74.00	17.19	1000.0	1000.000	201.0	V	90.0	35
17857.033333	56.49	---	74.00	17.51	1000.0	1000.000	147.0	V	303.0	35
17862.233333	56.62	---	74.00	17.38	1000.0	1000.000	150.0	V	356.0	35
17910.600000	58.14	---	74.00	15.86	1000.0	1000.000	150.0	V	228.0	36
17969.433333	58.21	---	74.00	15.79	1000.0	1000.000	105.0	V	303.0	37
17972.966667	---	45.74	54.00	8.26	1000.0	1000.000	115.0	V	356.0	37

6.3.2 Radiated disturbances (18 GHz to 26 GHz)

Instruments and accessories

ID	Description	Manufacturer	Model	Serial No.	Status	Cal. date	Cal. due
P1326	EMI receiver	R&S	ESU26	100058	cal	Apr 05, 2018	Apr 2020
P1299	video camera MZ3	Pontis		6410703001	ind		
P1303	Mast (MZ3)	innco GmbH	MA 4660-XPET		cnn		
P1304	Controller	innco GmbH	CO 3000	CO3000/915	cnn		
P1148	antenna (horn 18 - 40GHz)	Emco	3116	9904-2425	cal	May 25, 2018	May 2020
P1197	preamplifier 18-40GHz	miteq	JS4-18004000-33-5A	1037333	cal	May 03, 2018	May 2020
P2080	coax cable 40 GHz	Rosenberger Micro-Coax	LA1-036-5000		cal	Apr 10, 2019	Apr 2021
P2472	Digital Optical Transmitter f. USB Signals	mk Messtechnik (EMCO)	optoUSB2.0 + BP-84	19-016426+19-016427+19-016354	cnn		
P1914	Data logger for humidity and temperature (MZ3)	testo AG	testo 175 H1	40342576	cal	Aug 19, 2017	Aug 2020
P0338	test chamber 3	Siemens			chk	Feb 22, 2019	Feb 2020

cal = Calibration, car = Calibration restricted use, chk = Check, chr = Check restricted use, cpu = Check prior to use, calchk = Calibration and check, ind = for indication only, cnn = Calibration not necessary, man = Maintenance

Photo documentation of the test set-up:

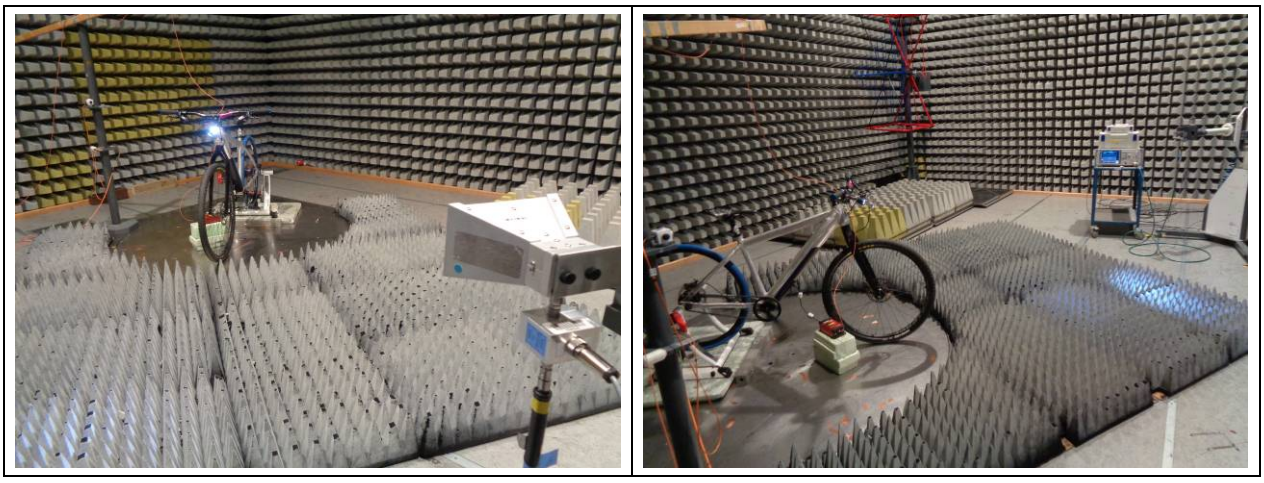


Figure 6-10: test setup for radiated disturbances 18 GHz to 26 GHz

Result:

verdict:	**pass**

For detailed results, please see below.

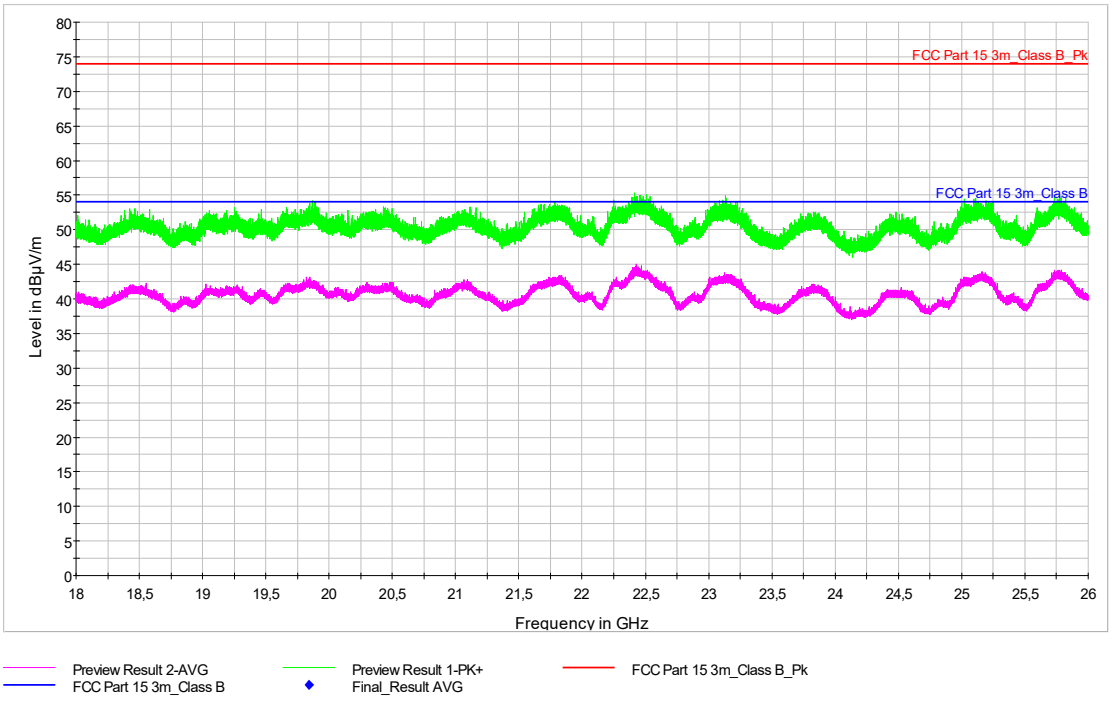


Figure 6-11: Graphical presentation Radiated disturbances 1 GHz to 26 GHz

Result table:

None

7 Disclaimer

This document is issued by the Company subject to its General Conditions of Service (www.sgsgroup.de/agb). Attention is drawn to the limitations of liability, indemnification and jurisdictional issues established therein.

This document is an original. If the document is submitted digitally, it is to be treated as an original within the meaning of UCP 600.

Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

End of Test Report