Bundesnetzagentur
BNetzA-CAB-14/21-09

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

# SGS Germany GmbH

# Test Report No.: P0GN0005

## FCC ID: 2AVOXFZEV

**Order No.:** P0GN **Pages:** 32

| | |
|---|---|
| Client: | Fazua GmbH |
| Equipment Under Test: | FAZUA RIDE 50 Pedelec Drive Unit |
| Manufacturer / Importer: | FAZUA GmbH |
| Task: | Compliance with the requirements mentioned below: |
| Test Specification(s): [covered by accreditation] | • FCC 47 CFR Part 15<br>§15.107<br>§15.109<br>• 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.

| **approved by:** | **Date** | **Signature** |
|---|---|---|
| More<br>Group Leader | May 04, 2022 | |

This document was signed electronically.

## CONTENTS

# 1 Result Summary

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 | NA |
| 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 - 2 GHz [3] | Class B | P |
| Conducted Emission AC power port[2] | ICES-003 | 150 kHz – 30 MHz | Class B | NA |
| Radiated Emission Electric Field | ICES-003 | 30 MHz - 1 GHz | Class B | P |
| Radiated Emission Electric Field | ICES-003 | 1 GHz - 2 GHz[3] | Class B | P |



**The test program was conducted to evaluate the new design of the product previously designated as Evation. The test results of the Evation are documented in the test report number P0GN0003.**

The current series, designated Evation, is to be continued under the new designation RIDE 50.

In the process, the previous product or model designation for the motor unit changes from evation Drivepack to RIDE 50 Drivepack, which is divided into two model variants: TRAIL / STREET.

Evation Drivepack becomes RIDE 50 STREET for use in road bike pedelecs. RIDE 50 TRAIL for use in moutain bike pedelecs.

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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

The RIDE 50 Drivepacks, will only have stronger magnets installed in the same motor (like evation), which will increase the mechanical torque from 55 Nm to 58 Nm at the same power consumption.

The previous product or model designation for the Evation Battery 250 X changes to Energy 250X.

No changes are made to the electronic parts and components, so there are no safety-related issues in this area. No critical components (see Listing Report) in the motor assembly and in the lithium-ion battery are touched.

There are no changes to the battery.

Only the external design of the Drivepacks (motor unit) is slightly changed. The design of the cooling fins on the radiator have been adapted, using the same material and having the same cooling capacity. the volume of the material also remains the same.

These changes do not affect stability, since the radiator is not a load-bearing component. EMC behaviour is slightly different from original but remain compliant.

# 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

[5] Test Report P0GN0003

## 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

## 3.2 Test Laboratory

SGS Germany GmbH
Hofmannstraße 50
81379 München



## 3.3 Time Schedule

Delivery of EUT: Jun 16, 2021
Start of test: Jun 16, 2021
End of test: Jun 16, 2021

## 3.4 Participants

| Name | Function |
|---|---|
| Rami Ben Hassine | Accredited testing, Editor |

## 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 .....:** | Pedelec (EPAC) |
| Trademark..... .....: | FAZUA |
| Manufacturer / Importer .. .....: | FAZUA GmbH |
| Model/Type ..... .....: | FAZUA RIDE 50 Pedelec Drive Unit |
| Number of tested samples....: | One EPAC with integrated drive unit and battery |
| Serial Number(s) ..... .....: | Representative test bike with |
| | RIDE 50 Drivepack TRAIL, SN: 3501011793 |
| | Bottom Bracket, SN: 3902007358 |
| | Remote FX, SN: 4207083167 |
| | ENERGY 250 X, SN: 3305410025 |

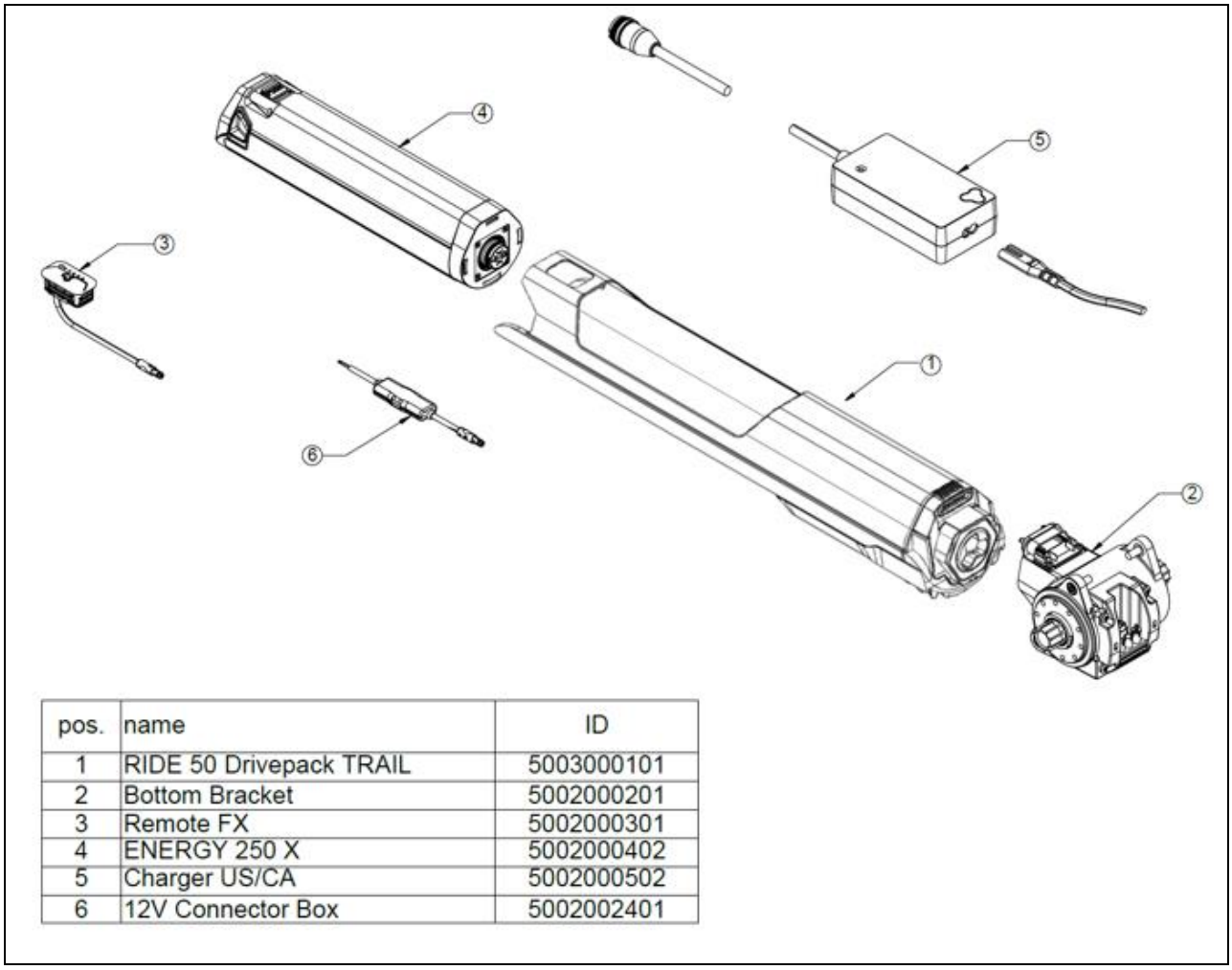


The FAZUA RIDE 50 is an electric motor support system for Pedelecs (EPAC). It is designed for Pedelec 25 usage (limited to 25 km/h). The system has a modular design configuration to achieve a high level of integration into the bicycle frames, the power to weight ratio and user flexibility.

FAZUA RIDE 50 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 FAZUA RIDE 50 as shown in Figure 4-1 are as following:

1. RIDE 50 Drivepack TRAIL
2. Bottom Bracket
3. Remote FX
4. ENERGY 250 X (Li-Ion 10INR19/66-2, capacity 252 Wh)
5. Charger US/CA
6. 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 | RIDE 50 Drivepack TRAIL | 5003000101 |
| 2 | Bottom Bracket | 5002000201 |
| 3 | Remote FX | 5002000301 |
| 4 | ENERGY 250 X | 5002000402 |
| 5 | Charger US/CA | 5002000502 |
| 6 | 12V Connector Box | 5002002401 |

**Figure 4-1: Main components of FAZUA RIDE 50**



**Pedelec (EPAC) with Drive Unit**

**Remote FX (tested)**


**ENERGY 250 X (tested)**



**DrivePack (tested)**

**Bottom Bracket (tested)**

**Figure 4-2: Main components of FAZUA RIDE 50 Pedelec Drive unit with Remote, Battery, DrivePack and Bottom Bracket**


**ENERGY 250 X**



**Drivepack RIDE 50 TRAIL**

**Bottom Bracket**

**Figure 4-5: Copy of type plates**

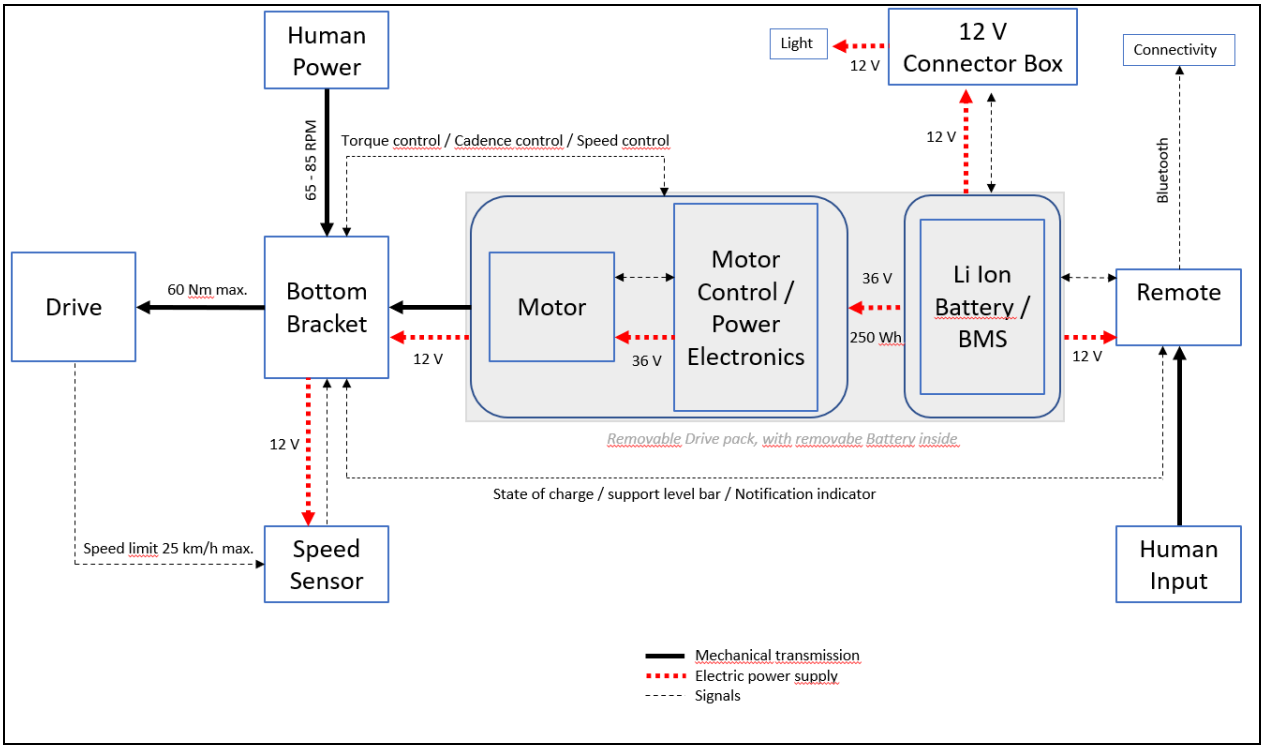



**Figure 4-6: Block diagram of function for the FAZUA RIDE 50 Pedelec Drive Unit**

## 4.1 Operational conditions

### 4.1.1 Software

Software necessary for operating, controlling and monitoring the EUT:

| Name | Identification Code/Issue | Task |
|---|---|---|
| FAZUA Service tool box | Version: 2.04 | Configuration, controls and monitoring of EUT parameters |

### 4.1.2 Operation modes

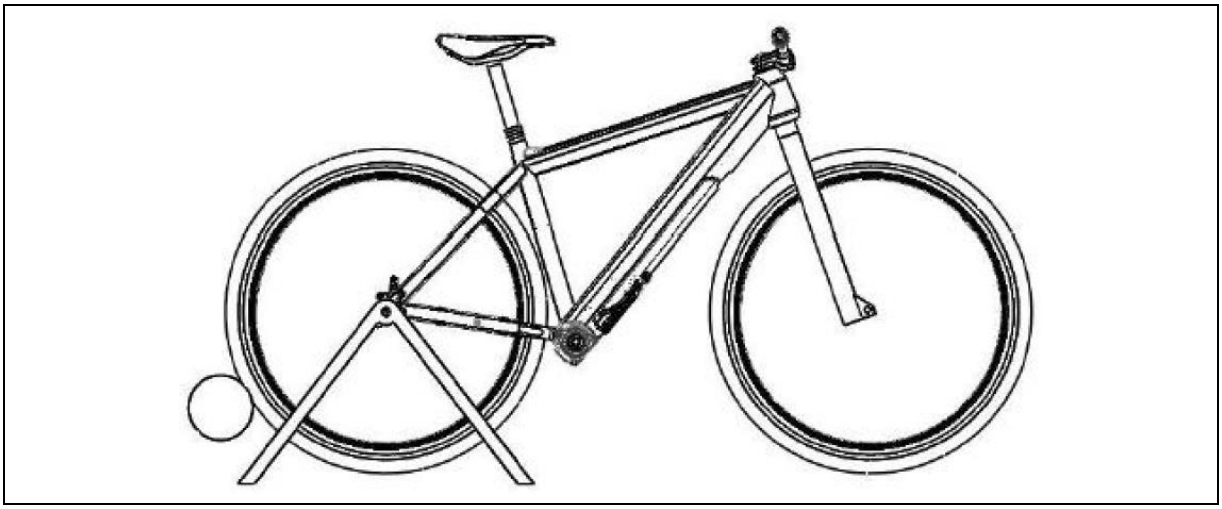
☐ Normal operation

☒ Other operation:

The Operation mode on EPAC during the test is: Driving

### 4.1.3 Configuration mode

#### 4.1.3.1 Configuration mode 1



| | |
|---|---|
| Mode | 180 W |
| Motor speed | 3000 RPM |
| Motor torque | 1.0 Nm |
| Gear (11-fold) | Gear 6 |
| Speed (EPAC) | 22 km/h (98 % speed) particularly during the radiated Emission test |
| Controlling of motor during testing | Computer via USB connection / Remote via FAZUA Service Toolbox / special software for stand-alone operating mode |
| Roller dynamometer | Training bike stand (ELITE or Tacx) |

## 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 |
| RIDE 50 Drive-pack TRAIL | SN: 3501011793 | Rosenberger connector type B001-12-XXX-C | 1 |
| Bottom Bracket | AN: 5002000201<br>SN: 3902007358 | screwed to the bicycle frame | 1 |
| ENERGY 250 X | SN: 3305410025 / 3305410047 | integrated in the DrivePack, Rosenberger connector type Discharge C003-G3_300-C Charge B001-28-65-C | 1 |
| Remote FX | SN: 4207083167 | integrated in the frame, connected to bottom bracket via electrical plug connection | 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 |
|---|---|---|---|---|---|
| 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 |
|---|---|---|---|
| --- | --- | --- | --- |

[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)<br>**8 MHz** (CAN controller) | |
| **BATTERY 250 X**<br>(Battery pack) | **40 MHz** (MCU)<br>**32.768 kHz** (low frequency clock) | 8 MHz (MCU) x 5 |
| **DRIVEPACK**<br>(Motor unit) | **48 MHz** (MCU)<br>**8 MHz** (CAN controller)<br>**250 MHz** (xCORE motor control chip)<br>**32.768 kHz** (low frequency clock) | 250 kHz for CAN-Bus communication |
| **REMOTE fX** | **32 MHz** (MCU)<br>**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. |

The highest clock frequency of the EUT during the Drive operation mode is: 250 MHz

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

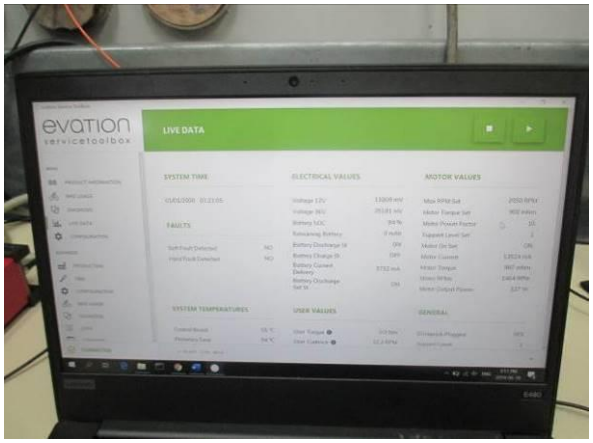
### 4.2.6 Modifications during the test

None

### 4.2.7 Operation and monitoring equipment

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

FAZUA 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*:**<br>***30 – 1000 MHz (d = 10 m)***<br>- NSA acc. to:<br>・ CISPR 16-1-4<br>・ ANSI C63.4<br>***1 – 18 GHz (d = 3 m)***<br>Site VSWR 1 – 18 GHz acc. to CISPR 16-1-4 | ***Emission*:**<br>***30 – 1000 MHz (d = 3 m)***<br>- NSA acc. to:<br>・ CISPR 16-1-4<br>・ ANSI C63.4<br>***1 – 18 GHz (d = 3 m)***<br>Site VSWR 1 – 18 GHz acc. to CISPR 16-1-4 | ***Emission*:**<br>***30 – 1000 MHz (d = 3 m)***<br>- NSA acc. to:<br>・ CISPR 16-1-4<br>・ ANSI C63.4<br>***1 – 18 GHz (d = 3 m)***<br>Site VSWR 1 – 18 GHz acc. to CISPR 16-1-4 | | |
| | ***Immunity:***<br>Field uniformity<br>27 – 6000 MHz acc.<br>IEC/EN 61000-4-3 | ***Immunity:***<br>Field uniformity<br>80 – 6000 MHz acc.<br>IEC/EN 61000-4-3 | ***Immunity:***<br>Field uniformity<br>80 – 6000 MHz acc.<br>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.

Expanded uncertainty:

| | | |
|---|---|---|
| Conducted emission | 0.15 – 30 MHz | + 2.2 dB / -2.5 dB |
| Radiated emission | 30 – 1000 MHz | +3.1 dB / -3.9 dB |
| Radiated emission | 1 – 6 GHz | +3.9 dB / -5.2 dB |
| Radiated emission | 6 – 18 GHz | +4.2 dB / -5.7 dB |

## 5.3 Statement of Conformity & Decision Rule

Concerning radiated/conducted emission, if not otherwise stated in the relevant standards, the decision rule for statement of conformity is based on $U_{CISPR}$ given in CISPR 16-4-2. When the expanded uncertainty calculations of the EMC-lab for the single emission tests is below $U_{CISPR}$, then it can be considered, based on ILAC-G8, that the measurement result is valid without any need of adaption and e.g. a result of 0 dB to the limit can be stated as pass.

Concerning immunity tests the required levels are created and coupled within the required uncertainty limits which are given in the relevant standards or are typical for that kind of phenomena. Unless differently specified in the standards, to assess the conformity of the EUT, the laboratory applies the decision rule defined in the referenced product standards. The given compliance criteria listed in the basic and product standards (e.g. A, B, C; functional status, …) are related with the pass/fail- and performance criteria of the tested sample given from the client or test plan.

# 6 Test Conditions and Results

## 6.1 Conducted disturbance (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 | NA |
| Conducted Emission AC Power Ports | ICES-003 | 150 kHz – 30 MHz | Class B | NA |

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

## 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<br>distance 3 m | Class B | P |
| Radio Disturbance Electric Field | ICES-003 | 30 MHz - 1 GHz<br>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.)**

Tested by : Ben Hassine

Test date : 2021-06-16 Test location : EMC chamber No. 3

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.

EMC-Test-SW: EMC32 version 10.60.20 (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 01, 2020 | Apr 2022 |
| 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 07, 2020 | Aug 2023 |
| P0338 | EMC chamber 3 | Siemens | | | chk | | |

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, service = Wartung (Service), man = Maintenance, calservice = Calibration & Service, chkservice = Check & Service, calchkservice = Calibration & Check & Service



## Photo documentation of the test set-up:


**Figure 6-1: test setup for Radiated disturbances 30 MHz to 1000 MHz**

## Result:

| verdict: | pass |
|---|---|

For detailed results, please see below.

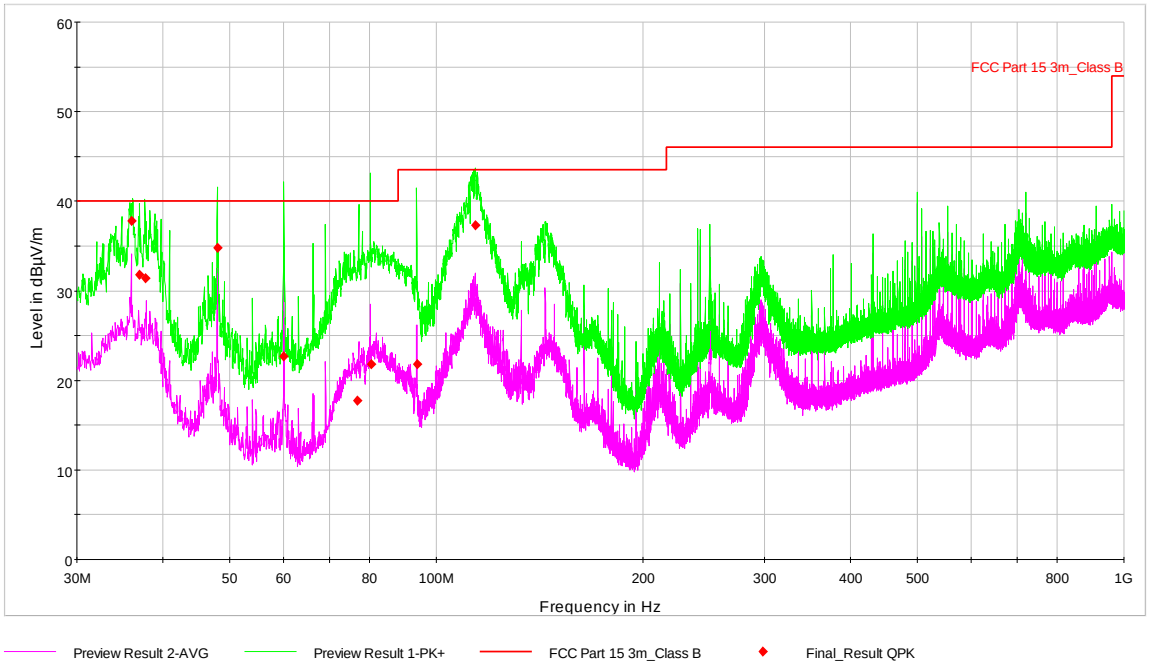



**Figure 6-2: Graphical presentation Radiated disturbances 30 MHz to 1000 MHz**

## 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) |
|---|---|---|---|---|---|---|---|---|---|
| 36.059500 | 37.80 | 40.00 | 2.20 | 15000.0 | 120.000 | 110.0 | V | 356.0 | 16 |
| 36.932500 | 31.81 | 40.00 | 8.19 | 15000.0 | 120.000 | 102.0 | V | -2.0 | 16 |
| 37.763000 | 31.40 | 40.00 | 8.60 | 15000.0 | 120.000 | 121.0 | V | 27.0 | 15 |
| 48.013500 | 34.76 | 40.00 | 5.24 | 15000.0 | 120.000 | 203.0 | V | 85.0 | 10 |
| 59.873000 | 22.69 | 40.00 | 17.31 | 15000.0 | 120.000 | 325.0 | H | 235.0 | 6 |
| 76.773500 | 17.73 | 40.00 | 22.27 | 15000.0 | 120.000 | 405.0 | H | 120.0 | 7 |
| 80.297500 | 21.80 | 40.00 | 18.20 | 15000.0 | 120.000 | 181.0 | H | 227.0 | 8 |
| 93.772000 | 21.77 | 43.50 | 21.73 | 15000.0 | 120.000 | 196.0 | V | 245.0 | 10 |
| 113.788000 | 37.32 | 43.50 | 6.18 | 15000.0 | 120.000 | 100.0 | V | 153.0 | 12 |

## 6.3 Radiated disturbances (1 GHz to 2 GHz)

| Phenomena | Reference | Frequency Range | Criteria | Verdict [1] |
|---|---|---|---|---|
| Radio Disturbance Electric Field | FCC 47 CFR Part 15 §15.109 | 1 GHz - 2 GHz<br>Distance 3 m | Class B | P |
| Radio Disturbance Electric Field | ICES-003 | 1 GHz - 2 GHz<br>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 : Ben Hassine

Test date : 2021-06-16 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 2 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.

EMC-Test-SW: EMC32 version 10.60.20 (R&S)

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

## Instruments and accessories

| ID | Description | Manufacturer | Model | Serial No. | Status | Cal. date | Cal. due |
|---|---|---|---|---|---|---|---|
| P1326 | EMI receiver | R&S | ESU26 | 100058 | cal | Apr 01, 2020 | Apr 2022 |
| 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 14, 2020 | Apr 2022 |
| P1650 | preamplifier (MZ3) | Kuhne electronic | KU LNA BB 202 A | | cal | Mar 24, 2021 | Mar 2023 |
| 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 07, 2020 | Aug 2023 |
| P0338 | EMC chamber 3 | Siemens | | | chk | | |

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, service = Wartung (Service), man = Maintenance, calservice = Calibration & Service, chkservice = Check & Service, calchkservice = Calibration & Check & Service

## Photo documentation of the test set-up:

**Figure 6-3: test setup for radiated disturbances 1 GHz to 2 GHz**

## Result:

| verdict: | pass |
|---|---|

For detailed results, please see below.

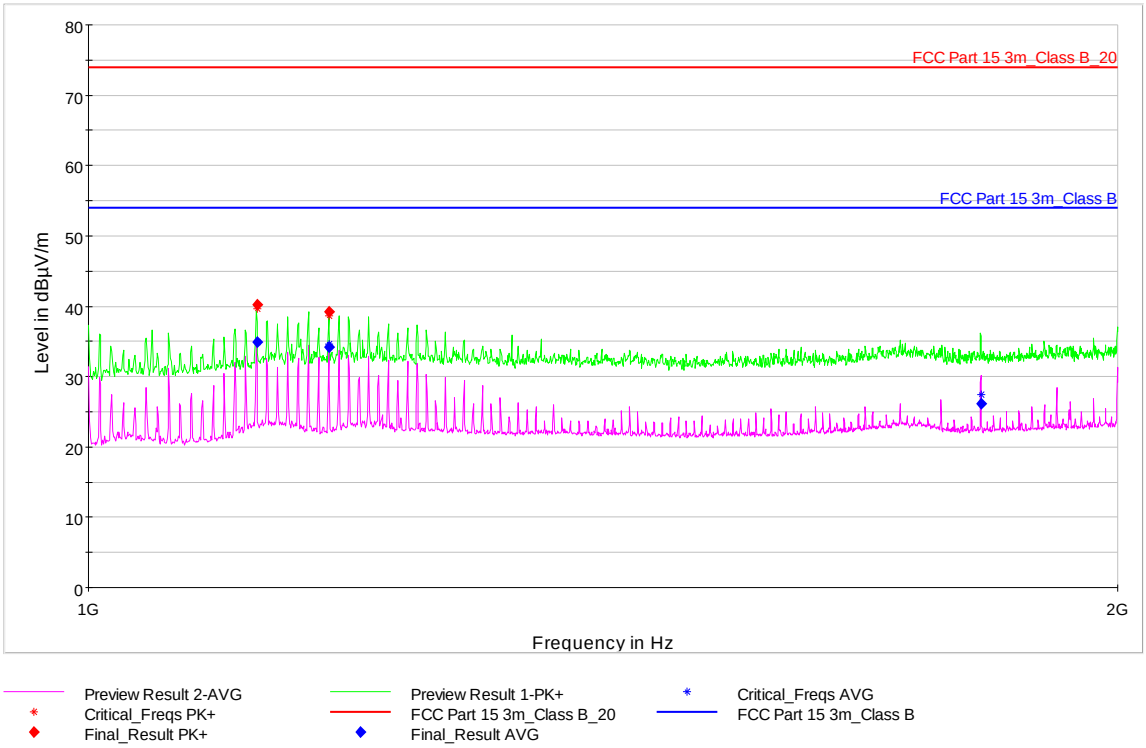



**Figure 6-4: Graphical presentation Radiated disturbances 1 GHz to 2 GHz**



## 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) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1120.166667 | --- | 34.92 | 54.00 | 19.08 | 1000.0 | 1000.000 | 101.0 | V | 125.0 | -2 |
| 1120.166667 | 40.25 | --- | 74.00 | 33.75 | 1000.0 | 1000.000 | 101.0 | V | 128.0 | -2 |
| 1175.866667 | --- | 34.17 | 54.00 | 19.83 | 1000.0 | 1000.000 | 105.0 | H | 137.0 | -2 |
| 1175.866667 | 39.25 | --- | 74.00 | 34.75 | 1000.0 | 1000.000 | 104.0 | V | 231.0 | -2 |
| 1824.133333 | --- | 26.18 | 54.00 | 27.82 | 1000.0 | 1000.000 | 196.0 | V | 192.0 | 2 |

# 7 Disclaimer

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**End of Test Report**