

**TEST REPORT # EMCC-180541BGC, 2019-08-30****EQUIPMENT UNDER TEST:**

Trade Name: Edge FCR 3  
Type: 110012  
Serial Number(s): 00001101  
Application: Edge Computing Device  
FCC ID: 2ASE6EDGEFCR3  
Manufacturer: MYNXG Product GmbH  
Address: Friedhofstraße 72  
63263 Neu-Isenburg  
GERMANY  
Name: Mr Christian Winkelmeyr  
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**RELEVANT STANDARD(S) :** KDB 996369 D04 Module Integration Guide v01  
47 CFR § 15.209

**MEASUREMENT PROCEDURE: :** ANSI C63.10-2013

**TEST REPORT PREPARED BY:**

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Tested:



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- Head of Laboratory -

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## 0 REVISION HISTORY

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| Project number | Issue date | Chapter | Description   |
|----------------|------------|---------|---------------|
| 180541BGC      | 2019-08-30 | n.a.    | Initial issue |

## 1 GENERAL INFORMATION

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### 1.1 Purpose

The purpose of this report is to show compliance with the modular transmitter integration guide 996369 D04 Module Integration Guide v01.

### 1.2 Limits and Reservations

The test results in this report apply only to the particular equipment under test (EUT) as declared in this report. This test report shall not be reproduced except in full without the written permission of EMCCons DR. RAŠEK GmbH & Co. KG.

### 1.3 Test Laboratory

|                                                |                                                                                            |
|------------------------------------------------|--------------------------------------------------------------------------------------------|
| Test Laboratory:                               | EMCCons DR. RAŠEK GmbH & Co. KG                                                            |
| Accreditation No.:                             | D-PL-12067-01-04                                                                           |
| Address of Labs I, II, III<br>and Head Office: | EMCCons DR. RAŠEK GmbH & Co. KG<br>Boelwiese 8<br>91320 Ebermannstadt<br>GERMANY           |
| Address of Labs IV and V:                      | EMCCons DR. RAŠEK GmbH & Co. KG<br>Stoernhofer Berg 15<br>91364 Unterleinleiter<br>GERMANY |
| Phone:                                         | +49 9194 7262-0                                                                            |
| Fax:                                           | +49 9194 7262-199                                                                          |
| E-Mail:                                        | info@emcc.de                                                                               |
| Web:                                           | www.emcc.de                                                                                |

### 1.4 Customer

|               |                        |
|---------------|------------------------|
| Company Name: | MyOmega Systems GmbH   |
| Street:       | Neumeyerstraße 28 - 34 |
| City:         | 90411 Nuremburg        |
| Country:      | GERMANY                |
| Name:         | Ms Gaby Möller         |
| Phone:        | +49 911 990 876-21     |
| Fax:          | n/a                    |
| E-Mail:       | gaby.moeller@mynxg.com |

### 1.5 Manufacturer

|               |                                |
|---------------|--------------------------------|
| Company Name: | MYNXG Product GmbH             |
| Street:       | Friedhofstraße 72              |
| City:         | 63263 Neu-Isenburg             |
| Country:      | Germany                        |
| Phone:        | +49 911 990 876 22             |
| E-Mail:       | christian.winkelmeyr@mynxg.com |

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**1.6 Dates and Test Location**

Date of receipt of EUT: 2019-07-02  
Test Date: 2019-08-01  
Test Location: Lab IV

**1.7 Ordering Information**

Purchase Order: DE20190701\_067  
Date: 2019-07-01  
Vendor-Number: n/a

**1.8 Climatic Conditions**

| Date       | Temperature | Relative Humidity | Air Pressure | Lab | Customer attended tests |
|------------|-------------|-------------------|--------------|-----|-------------------------|
| --         | °C          | %                 | hPa          | --  | --                      |
| 2019-08-01 | 26          | 44                | 977          | IV  | Yes,<br>Mr Tragkas      |

## 2 PRODUCT DESCRIPTION

### 2.1 Equipment Under Test (EUT)

The following data is based on customer's information.

|                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                   |                                             |
|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|---------------------------------------------|
| Manufacturer:                 | MYNXG Product GmbH                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                   |                                             |
| Trade Name:                   | Edge FCR 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                   |                                             |
| Type:                         | 110012                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                   |                                             |
| Application:                  | Edge Computing Device                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                   |                                             |
| No of variants:               | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                   |                                             |
| Serial No(s):                 | 00001101                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                   |                                             |
| Firmware version:             | 2.2.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                   |                                             |
| Hardware version:             | 2.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                   |                                             |
| FCC ID:                       | 2ASE6EDGEFCR3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                   |                                             |
| Internal clock:               | 1.46 GHz (CPU)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                   |                                             |
| Radio Technologies:           | ISM Radio                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | WIFI                              | UMTS/LTE                                    |
| Operating Frequency Range:    | 913 ... 917 MHz                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 2412 ... 2472 MHz                 | see following tabels                        |
| TX Power:                     | 19 dBm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 27 dBm (IEEE 802.11g)             | 24 dBm (UMTS)<br>23 dBm (LTE)               |
| Used TX Frequencies for test: | 915 MHz                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 2437 MHz                          | 1852.4 MHz *                                |
| Antenna(s):                   | external, SMA,<br>type: V-Torch VT4GLTE-R-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | external, RP-SMA,<br>type: JCW913 | external, SMA,<br>type: V-Torch VT4GLTE-R-1 |
| Max Antenna Gain:             | 0 dBi                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 5 dBi                             | 4 dBi                                       |
| Power Supply:                 | DC Power Supply 24 V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                   |                                             |
| Ports:                        | Port 1: USB, for service, only<br>Port 2: Ethernet RJ45 (ETH0)<br>Port 3: Ethernet RJ45 (ETH1) – is for development and debugging only. It is deactivated for productive parts in BIOS<br>Port 4: I2C<br>Port 5: Current loop with HART interface, 4 channels, unlimited cable length<br>Port 6: Analog terminal block, 2 channels<br>Port 7: RS 323/485<br>Port 8: DC Power (DC jack for table top use)<br>Port 9: DC Power (2 pin connector for DIN Rail use)<br>Port 10: Display Port, for service, only |                                   |                                             |
| Remarks:                      | None                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                   |                                             |

\* Module provides UMTS and LTE operation, one frequency selected in the UMTS range, due to highest RF output power.

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EUT information on module WLE200N2 was taken from report SA980630H04, dated 2013-04-26.

**6.2 Output Power Into Antenna & RF Exposure value at distance 20cm:**
**For Dipole antenna :**
**For Part 802.11b:**

| Channel | Channel Frequency (MHz) | Output Power to Antenna (mW) | Power Density (mW/cm <sup>2</sup> ) | Limit of Power Density (mW/cm <sup>2</sup> ) |
|---------|-------------------------|------------------------------|-------------------------------------|----------------------------------------------|
| 1       | 2412                    | 156.571                      | 0.065                               | 1.0                                          |
| 6       | 2437                    | 159.809                      | 0.066                               | 1.0                                          |
| 11      | 2462                    | 133.677                      | 0.056                               | 1.0                                          |

**For Part 802.11g:**

| Channel | Channel Frequency (MHz) | Output Power to Antenna (mW) | Power Density (mW/cm <sup>2</sup> ) | Limit of Power Density (mW/cm <sup>2</sup> ) |
|---------|-------------------------|------------------------------|-------------------------------------|----------------------------------------------|
| 1       | 2412                    | 373.698                      | 0.155                               | 1.0                                          |
| 6       | 2437                    | 509.854                      | 0.212                               | 1.0                                          |
| 11      | 2462                    | 247.154                      | 0.103                               | 1.0                                          |

**DRAFT 802.11n (20MHz) OFDM**

| Channel | Channel Frequency (MHz) | Output Power to Antenna (mW) | Power Density (mW/cm <sup>2</sup> ) | Limit of Power Density (mW/cm <sup>2</sup> ) |
|---------|-------------------------|------------------------------|-------------------------------------|----------------------------------------------|
| 1       | 2412                    | 346.784                      | 0.144                               | 1.0                                          |
| 6       | 2437                    | 504.509                      | 0.210                               | 1.0                                          |
| 11      | 2462                    | 231.398                      | 0.096                               | 1.0                                          |

**DRAFT 802.11n (40MHz) OFDM**

| Channel | Channel Frequency (MHz) | Output Power to Antenna (mW) | Power Density (mW/cm <sup>2</sup> ) | Limit of Power Density (mW/cm <sup>2</sup> ) |
|---------|-------------------------|------------------------------|-------------------------------------|----------------------------------------------|
| 1       | 2422                    | 359.761                      | 0.150                               | 1.0                                          |
| 4       | 2437                    | 466.057                      | 0.194                               | 1.0                                          |
| 7       | 2452                    | 256.192                      | 0.106                               | 1.0                                          |

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EUT information on module L850-GL taken from test report SA17006C02, dated 2017-02-21

|                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EUT Type</b>                           | LTE module                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>FCC ID</b>                             | ZMOL850GL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Brand Name</b>                         | Fibocom                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Model Name</b>                         | L850-GL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Tx Frequency Bands<br/>(Unit: MHz)</b> | <p>WCDMA Band II : 1852.4 ~ 1907.6</p> <p>WCDMA Band IV : 1712.4 ~ 1752.6</p> <p>WCDMA Band V : 826.4 ~ 846.6</p> <p>LTE Band 2 : 1850.7 ~ 1909.3 (1.4M), 1851.5 ~ 1908.5 (3M), 1852.5 ~ 1907.5 (5M), 1855 ~ 1905 (10M), 1857.5 ~ 1902.5 (15M), 1860 ~ 1900 (20M)</p> <p>LTE Band 4 : 1710.7 ~ 1754.3 (1.4M), 1711.5 ~ 1753.5 (3M), 1712.5 ~ 1752.5 (5M), 1715 ~ 1750 (10M), 1717.5 ~ 1747.5 (15M), 1720 ~ 1745 (20M)</p> <p>LTE Band 5 : 824.7 ~ 848.3 (1.4M), 825.5 ~ 847.5 (3M), 826.5 ~ 846.5 (5M), 829 ~ 844 (10M)</p> <p>LTE Band 7 : 2502.5 ~ 2567.5 (5M), 2505 ~ 2565 (10M), 2507.5 ~ 2562.5 (15M), 2510 ~ 2560 (20M)</p> <p>LTE Band 12 : 699.7 ~ 715.3 (1.4M), 700.5 ~ 714.5 (3M), 701.5 ~ 713.5 (5M), 704 ~ 711 (10M)</p> <p>LTE Band 13 : 779.5 ~ 784.5 (5M), 782 (10M)</p> <p>LTE Band 17 : 706.5 ~ 713.5 (5M), 709 ~ 711 (10M)</p> <p>LTE Band 26 : 814.7 ~ 848.3 (1.4M), 815.5 ~ 847.5 (3M), 816.5 ~ 846.5 (5M), 819 ~ 844 (10M), 821.5 ~ 841.5 (15M)</p> <p>LTE Band 30 : 2307.5 ~ 2312.5 (5M), 2310 (10M)</p> <p>LTE Band 38 : 2572.5 ~ 2617.5 (5M), 2575 ~ 2615 (10M), 2577.5 ~ 2612.5 (15M), 2580 ~ 2610 (20M)</p> <p>LTE Band 41 : 2498.5 ~ 2687.5 (5M), 2501 ~ 2685 (10M), 2503.5 ~ 2682.5 (15M), 2506 ~ 2680 (20M)</p> <p>LTE Band 66 : 1710.7 ~ 1779.3 (1.4M), 1711.5 ~ 1778.5 (3M), 1712.5 ~ 1777.5 (5M), 1715.0 ~ 1775.0 (10M), 1717.5 ~ 1772.5 (15M), 1720.0 ~ 1770.0 (20M)</p> |
| <b>Uplink Modulations</b>                 | <p>WCDMA : QPSK</p> <p>LTE : QPSK, 16QAM</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Antenna Type</b>                       | External Antenna                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>EUT Stage</b>                          | Identical Prototype                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

**Note:**

1. The above EUT information is declared by manufacturer and for more detailed features description please refers to the manufacturer's specifications or User's Manual.



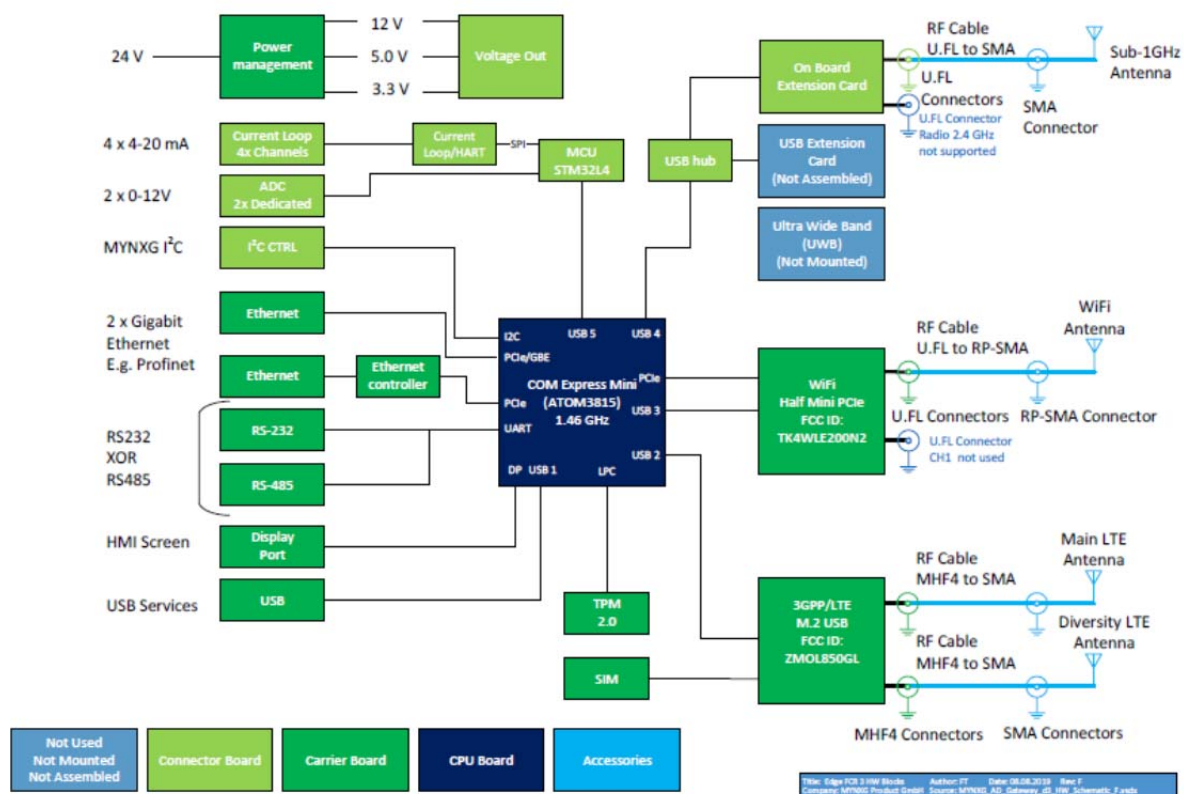
## Test on MYNXG Product GmbH Edge FCR 3 to KDB 996369 D04 Module Integration Guide v01

## 2.2 Intended Use

The following description was delivered by customer on 2019-08-26:

### 3 General Info

The MYNXG Edge FCR 3 is easy to install in any electrical cabinet. The Edge FCR 3 is optimized for machinery and shop floor monitoring. It is **the** smart edge computing solution. Through its rich wired and wireless interfaces, it can be integrated in any industrial environment. It is powered with the MYNXG Gateway OS combining the benefits of Android® and Linux® environments.



### 3.2 Intended use and typical operation mode

The Gateway d3 collects sensor data through the cable interfaces of the device and/or through wireless connections via the ISM or WiFi radio. The sensor data is processed and forwarded to a cloud server through a mobile (3G/4G) or WiFi connection.

The Edge FCR 3 does in normal operation mode poll or measure the sensor input approximately every 5 minutes and processes the data. About every 60 minutes the Gateway does forward the current status and data to a cloud server via WiFi or 3G/4G mobile network.

The ISM, WiFi and 3G/4G radios are operating independent and may therefore transmit simultaneously.

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## 2.3 EUT Peripherals/Simulators

Communication Tester Rohde & Schwarz CMW500 for UMTS communication.  
MYNXG Gateway d3 for WIFI communication.

## 2.4 Mode of operation during testing and test setup

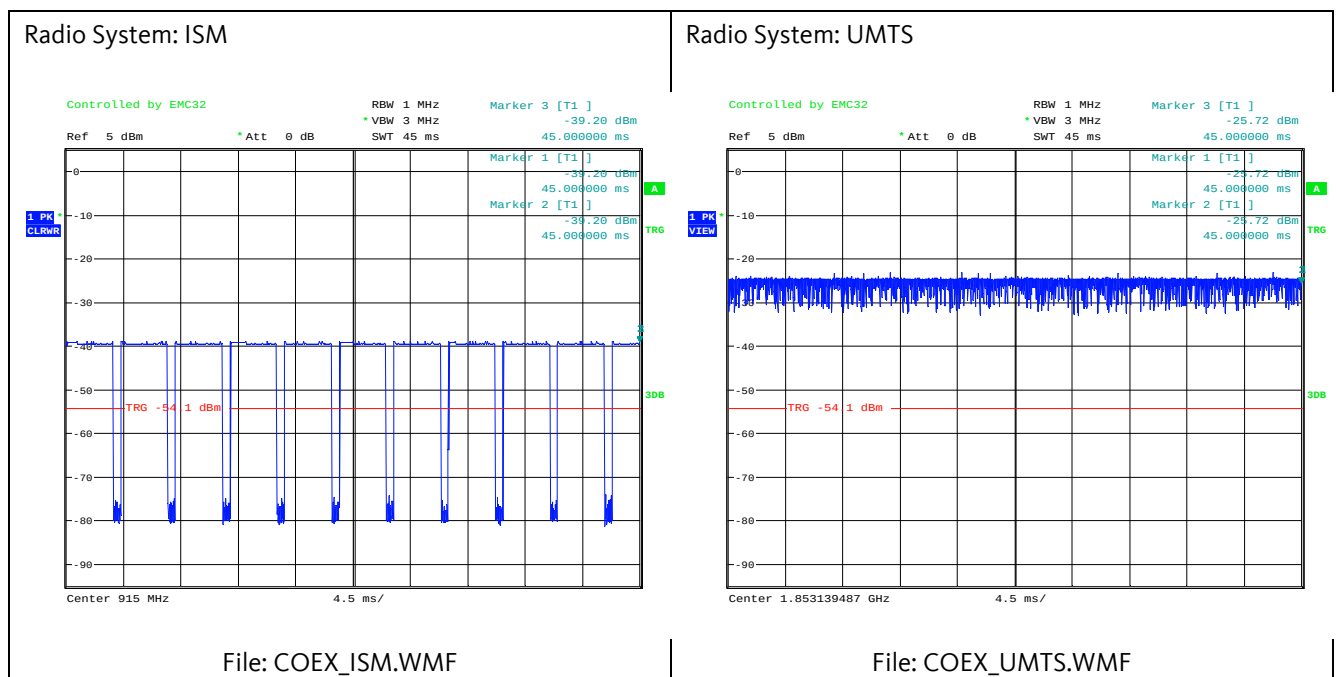
The equipment under test (EUT) was operated during the tests under the following conditions:

### Mode: Continuous Transmission

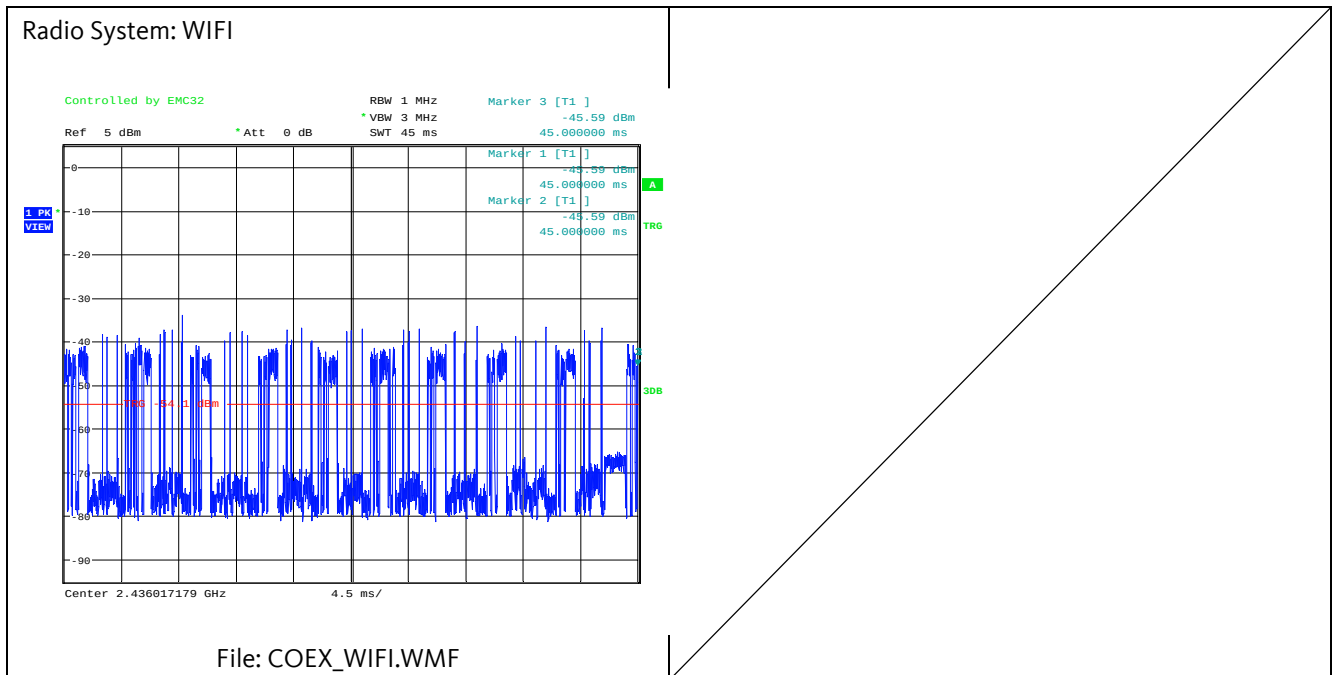
The EUT was set to continuous transmission with a high duty cycle of all three radios (ISM, UMTS and WIFI) simultaneously:

- The ISM radio was set by special test software, which forced the module to continuous transmission at 915 MHz with its maximum power (setting 19 dBm).
- The bi-directional UMTS connection was established by a Communication Tester (Rohde & Schwarz CMW500). The communication tester was set up in that way, that the EUT sends with its maximum power of 24 dBm at 1852.4 MHz. The high duty cycle was established by a high data throughput.
- The WIFI connection was established with a companion device (MYNXG Gateway d3 with special firmware) sending continuously ping packages to the EUT. The power was not adjustable. The used transmission frequency was 2437 MHz.

The following plots are showing the signal timing of the three radios.



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## 2.5 Modifications required for compliance

In order to comply with FCC regulations for radiated emissions, the following modifications were applied:

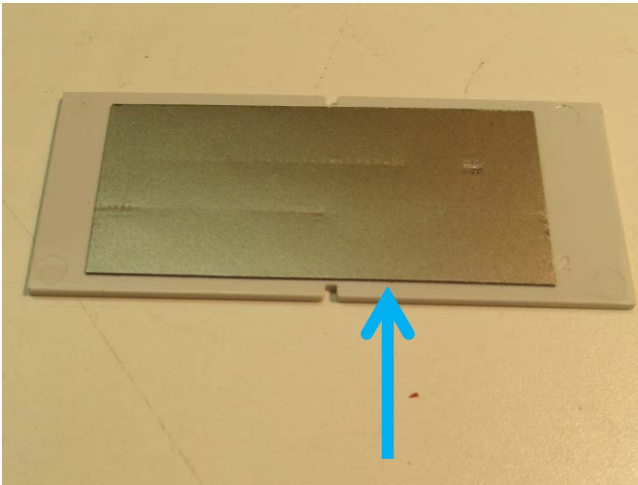
- One Ethernet port (the marked one) was deactivated in EUT's BIOS by disabling the corresponding PCIe lane.
- Some adhesive shielding material (type Thora elektronik A25000) was put on the lower and the rear part of the housing.
- the output power setting of the ISM radio was changed by software from 27 dBm to 19 dBm.



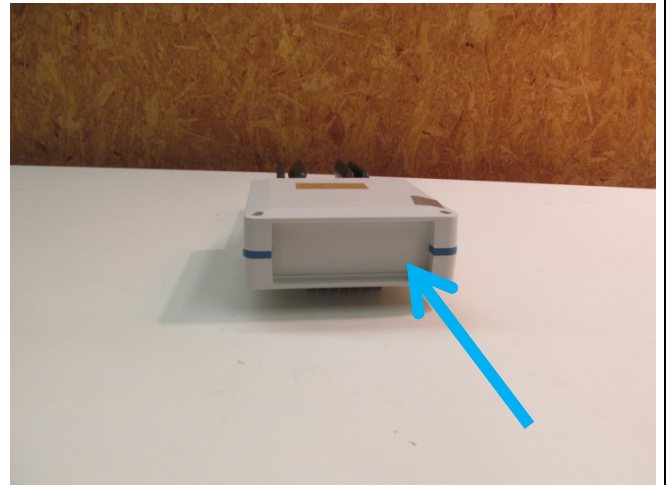
Deactivated Ethernet Port



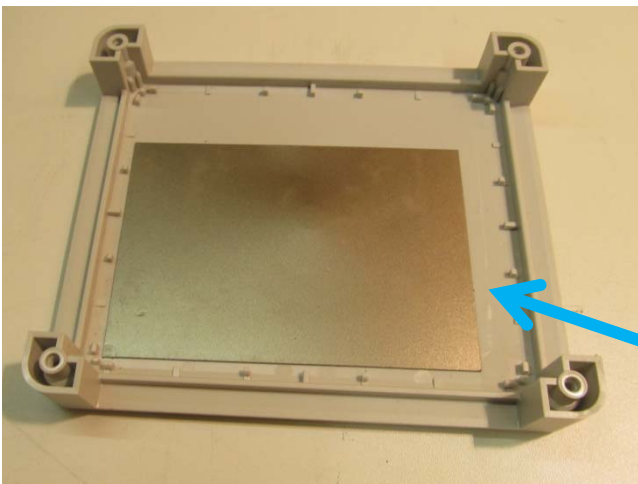
Shielding material at Connector Board



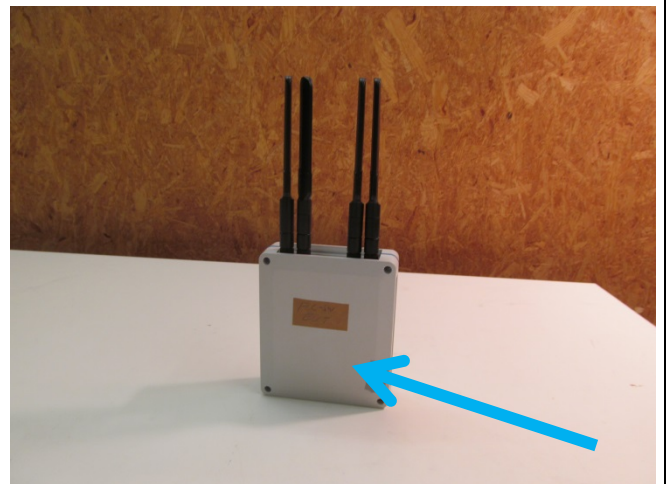
Shielding material at lower part of EUT housing (inside)



Installed lower part of EUT housing



Shielding material at rear part of EUT housing (inside)



Installed rear part of EUT housing

All tests in this report were performed with these modifications.

Note: the brown paper tape on the back side of the housing was used to identify the EUT during measurements. It is not part of the device.

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### 3 TEST RESULTS SUMMARY

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Summary of test results for the following EUTs:

Manufacturer: MYNXG Product GmbH  
Type: 110012  
Serial No.: 00001101

| Requirement        | 47 CFR Section | Report Section | Result |
|--------------------|----------------|----------------|--------|
| Radiated Emissions | 15.209         | 4.1            | Passed |
| Fundamental Power  | n/a            | 4.2            | n/a    |

N.A. – not applicable; N.T. – Not tested acc. to applicant's order.

The client has made the determination that EUT Condition, Characterization, and Mode of Operation are representative of production units and meet the requirements of the specifications referenced herein.

Consistent with Industry practice, measurement and test equipment not directly involved in obtaining measurement results but having an impact on measurements (such as cable loss, antenna factors, etc.) are factored into the "Correction Factor" documented in certain test results. Instrumentation employed for testing meets tolerances consistent with known Industry Standards and Regulations.

The measurements contained in this report were made in accordance with the procedures described in ANSI C63.10-2013 and all applicable Public Notices received prior to the date of testing. All requirements were found to be within the limits outlined in this report.

The test results in this report apply only to the particular equipment under test (EUT) as declared in this report.

Test personnel: Patrick Reusch

Issuance date: 2019-08-30

## 4 DETAILED TEST RESULTS

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### 4.1 Radiated Emissions

#### 4.1.1 Regulation

The following parameters were defined by test plan:

The tested frequency range of spurious emissions will be from 30 MHz to 18 GHz. The limits and measurement procedures specified in 47 CFR § 15.209 shall apply.

The fundamental power of the radio modules, which are not tested in the host product, were determined by radiated measurement following the procedures in ANSI C63.10-2013

#### **KDB 996369 D04 Module Integration Guide v01**

##### 3.0 HOST PRODUCT TESTING GUIDANCE

###### 3.1 General

Testing of the host product with all the transmitters installed is recommended, to verify that the host product meets all the applicable FCC rules. The radio spectrum is to be investigated with all the transmitters in the final host product functioning to determine that no emissions exceed the highest limit permitted for any one individual transmitter as required by Section 2.947(f). A formal application for certification submission containing the results of this investigation is not required. The host manufacturer is responsible to ensure that when their product operates as intended it does not have any emissions present that are out of compliance that were not present when the transmitters were tested individually.

The following provides general guidance and suggestions to host product manufacturers when installing a certified modular transmitter, on how they may verify the intentional radiator (transmitter) compliance of the composite-system end product.

- a) If the modular transmitter has been fully tested by the module grantee on the required number of channels, modulation types, and modes, it should not be necessary for the host installer to re-test all the available transmitter modes or settings. It is recommended that the host product manufacturer, installing the modular transmitter, perform some investigative measurements to confirm that the resulting composite system does not exceed the spurious emissions limits or band edge limits (e.g., where a different antenna may be causing additional emissions).
- b) The testing should check for emissions that may occur due to the intermixing of emissions with the other transmitters, digital circuitry, or due to physical properties of the host product (enclosure). This investigation is especially important when integrating multiple modular transmitters where the certification is based on testing each of them in a stand-alone configuration. It is important to note that host product manufacturers should not assume that because the modular transmitter is certified that they do not have any responsibility for final product compliance.
- c) If the investigation indicates a compliance concern the host product manufacturer is obligated to mitigate the issue. Host products using a modular transmitter are subject to all the applicable individual technical rules as well as to the general conditions of operation in Sections 15.5, 15.15, and 15.29 to not cause interference. The operator of the host product will be obligated to stop operating the device until the interference has been corrected.

###### 3.2 Frequency spectrum to be investigated

For host products with certified modular transmitter, the frequency range of investigation of the composite system is specified by rule in Sections 15.33(a)(1) through (a)(3), or the range applicable to the digital device, as shown in Section 15.33(b)(1), whichever is the higher frequency range of investigation. [...]

###### 3.3 Operating the host product

When testing the host product, all the transmitters must be operating. The transmitters can be enabled by using publicly-available drivers and turned on, so the transmitters are active. In certain conditions it might be appropriate to use a technology-specific call box (test set) where accessory devices or drivers are not available



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### 3.4 Emission measurements

- Measure the fundamental and unwanted/spurious emissions with the modular transmitter(s) operating in a normal mode.
- Perform testing on unwanted (spurious) radiated emissions on the worst-case modulation and channel per frequency range as shown in original filing.
- Where the transmitter power is based on ERP/EIRP or field strength, the host product manufacturer should ensure that installation of the modular transmitter has not affected the modular transmitter ERP/EIRP or its field strength rating. It should not be necessary to re-test the transmitter output power of any modular transmitter which has been certified based on conducted power.
- When power is not listed on the FCC grant, it should be assumed that the limit is based on field strength and that information will be in the associated test report in the modular transmitter application. The host product manufacturer may want to create a matrix based on test results

### 47 CFR § 15.209 Radiated emission limits; general requirements.

(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

| Frequency (MHz) | Field strength (microvolts/meter) | Measurement distance (meters) |
|-----------------|-----------------------------------|-------------------------------|
| 0.009-0.490     | 2400/F(kHz)                       | 300                           |
| 0.490-1.705     | 24000/F(kHz)                      | 30                            |
| 1.705-30.0      | 30                                | 30                            |
| 30-88           | 100**                             | 3                             |
| 88-216          | 150**                             | 3                             |
| 216-960         | 200**                             | 3                             |
| Above 960       | 500                               | 3                             |

\*\*Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

(e) The provisions in §§15.31, 15.33, and 15.35 for measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this part.

### 4.1.2 Calculation of Field Strength Limits

E.g. radiated emissions field strength limits for the frequency band 30 – 88 MHz:

100 µV/m at 3 meters

Using the equation:

$$E_{dB\mu V/m} = 20 \log (E_{\mu V/m})$$

where

$E_{dB\mu V/m}$  = Field Strength in logarithmic units (in dBµV/m)

$E_{\mu V/m}$  = Field Strength in linear units (in µV/m)

A field strength limit of 100 µV/m corresponds with 40.0 dBµV/m.

### 4.1.3 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF$$

where

FS = Field Strength (in dB $\mu$ V/m)

RA = Receiver Amplitude (in dB $\mu$ V)

AF = Antenna Factor (in dB (1/m))

CF = Cable Attenuation Factor (in dB)

Assume a receiver reading of 30 dB $\mu$ V is obtained. The Antenna Factor of 10 dB(1/m) and a Cable Factor of 1.2 dB are added, giving a field strength of 41.2 dB $\mu$ V/m in the measurement distance. The field strength of 41.2 dB $\mu$ V/m value can be mathematically converted to its corresponding level in  $\mu$ V/m.

$$FS = 30 + 10 + 1.2 = 41.2$$

$$\text{Level (in } \mu\text{V/m)} = \text{Common Antilogarithm } (41.2/20) = 114.8$$

For average measurements, the measured peak field strength is corrected by an AV correction factor. Please refer to chapter 2.6 for details.

#### Distance correction (field strength)

*Remark: The preferred method is the correction of the measured field strength instead of limit correction (refer to 4.2.2). Only one correction method shall be applied to a particular measurement..*

If a measurement is performed at a different distance other than specified, the field strength at the specified distance can be obtained by the following equation:

$$FS_{D_{\text{specified}}} = FS_{D_{\text{test}}} + 20 \log (D_{\text{test}}/D_{\text{specified}})$$

where

$FS_{D_{\text{specified}}}$  = Field Strength at specified distance  $D_{\text{specified}}$  (in dB $\mu$ V/m)

$FS_{D_{\text{test}}}$  = Field Strength at specified distance  $D_{\text{test}}$  (in dB $\mu$ V/m)

$D_{\text{test}}$  = Measurement distance where test was performed (in m)

$D_{\text{specified}}$  = Measurement distance as specified by the rules (in m)

Assuming a recorded field strength of 41.2 dB $\mu$ V/m in a distance of 1 m. If the rules are specifying a limit in a distance of 3 m, the field strength recorded in 1 m is corrected by the distance. Therefore, the field strength  $FS_{D_{\text{specified}}}$  is  $41.2 + 20 \log (1 / 3) = 31.7$  (in dB $\mu$ V/m).

*Remark: Using EMC32 software corrections are combined in the corr. factor as listed in the results' table.*

*"Result" represents the FS Result, "Corr." is the combined correction factor.*



#### 4.1.4 Radiated Emissions 30 MHz – 1000 MHz

##### 4.1.4.1 Test Procedures

###### **ANSI C63.10-2013 6.5 Radiated emissions from unlicensed wireless devices in the frequency range of 30 MHz to 1000 MHz**

This subclause specifies conditions for compliance testing in the frequency range above 30 MHz and below 1 GHz. The following subclauses describe the procedures that shall be used for making exploratory and final radiated emission tests for frequencies between 30 MHz and 1000 MHz. Measurements may be performed at a distance closer than that specified in the requirements, provided the measuring antenna is beyond its near-field range as determined by the Rayleigh criteria.

###### **ANSI C63.10-2013, 6.5.3 Exploratory radiated emission tests**

Exploratory measurements are used to identify the frequencies and amplitudes of the emissions while manipulating and rotating the EUT.

Exploratory radiated measurements shall be performed at the measurement distance or at a closer distance than that specified for compliance to determine the emission characteristics of the EUT. At near distances, for EUTs of comparably small size, it is relatively easy to determine the spectrum signature of the EUT and, if applicable, the EUT configuration that produces the maximum level of emissions. Exploratory measurements shall be made on a test site per 5.2. Shielded rooms, not treated with RF absorption material, shall not be used for exploratory measurements.

For each mode of operation required to be tested, the frequency spectrum shall be monitored. The highest signal levels relative to the limit shall be determined by rotating the EUT from 0° to 360° and with varying the measurement antenna height between 1 m and 4 m in vertical and horizontal polarizations.

###### **ANSI C63.10-2013, 6.5.4 Final radiated emission tests**

Using the orientation and equipment arrangement of the EUT, and based on the measurement results found during the exploratory measurement in 6.5.3, the EUT arrangement, appropriate modulation, and modes of operation that produce the emissions that have the highest amplitude relative to the limit shall be selected for the final measurement. The final measurement shall follow all the procedures in 6.3 with the EUT operating on frequencies per 5.6. For each mode selected, record the frequency and amplitude of the highest fundamental emission (if applicable) and the frequency and amplitude of the six highest spurious emissions relative to the limit; emissions more than 20 dB below the limit do not need to be reported.

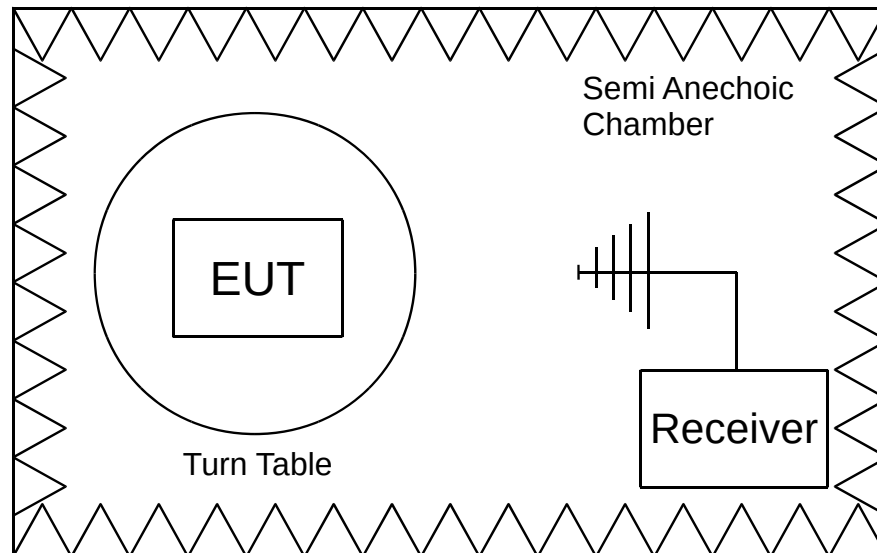
Measurements are performed with the EUT rotated from 0° to 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.

Variations in cable or wire placement shall be explored to maximize the measured emissions.

Unless specified otherwise by the regulatory authority, the instrumentation, detector functions, and bandwidths specified in 4.1.4.2.1 and 4.1.4.2.2 shall be used. For pulsed emissions, the procedure in 4.1.4.2.4 shall be used.

| Radiated Emissions Test Characteristics   |                             |
|-------------------------------------------|-----------------------------|
| Frequency range                           | 30 MHz – 1000 MHz           |
| Test distance                             | 3 m                         |
| EUT height                                | 0.8 m                       |
| Test instrumentation resolution bandwidth | 120 kHz                     |
| Receive antenna height                    | 1 m - 4 m                   |
| Receive antenna polarization              | Vertical/Horizontal         |
| Measurement location                      | Semi Anechoic Chamber (SAC) |

#### 4.1.4.2 Test Setup



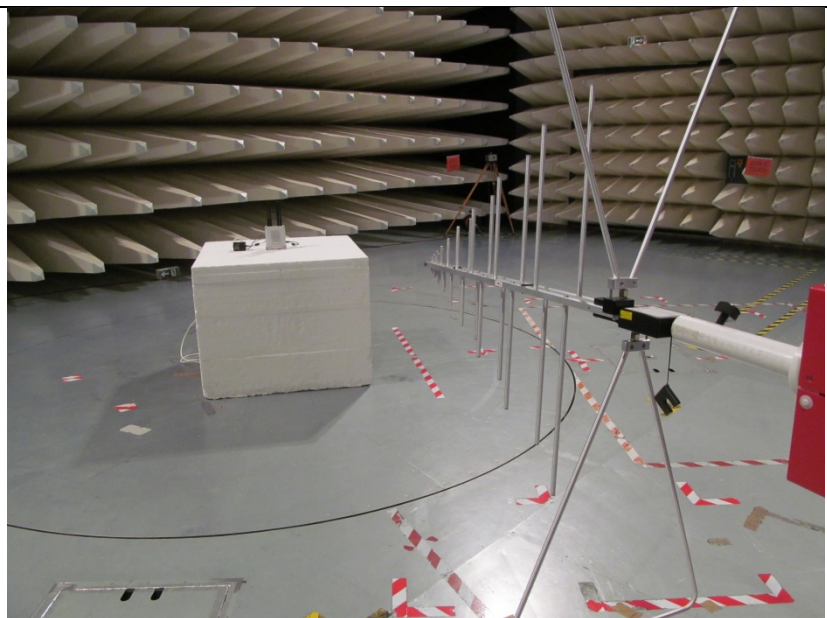
SCHEMATIC TEST SETUP

Requirement: 47 CFR, § 15.209  
Procedure: ANSI C63.10-2013  
KDB 996369 D04 v01

Test distance: 3 m  
EUT height: 0.8 m

TEST EQUIPMENT USED:  
Refer to chapter 5 of this document.

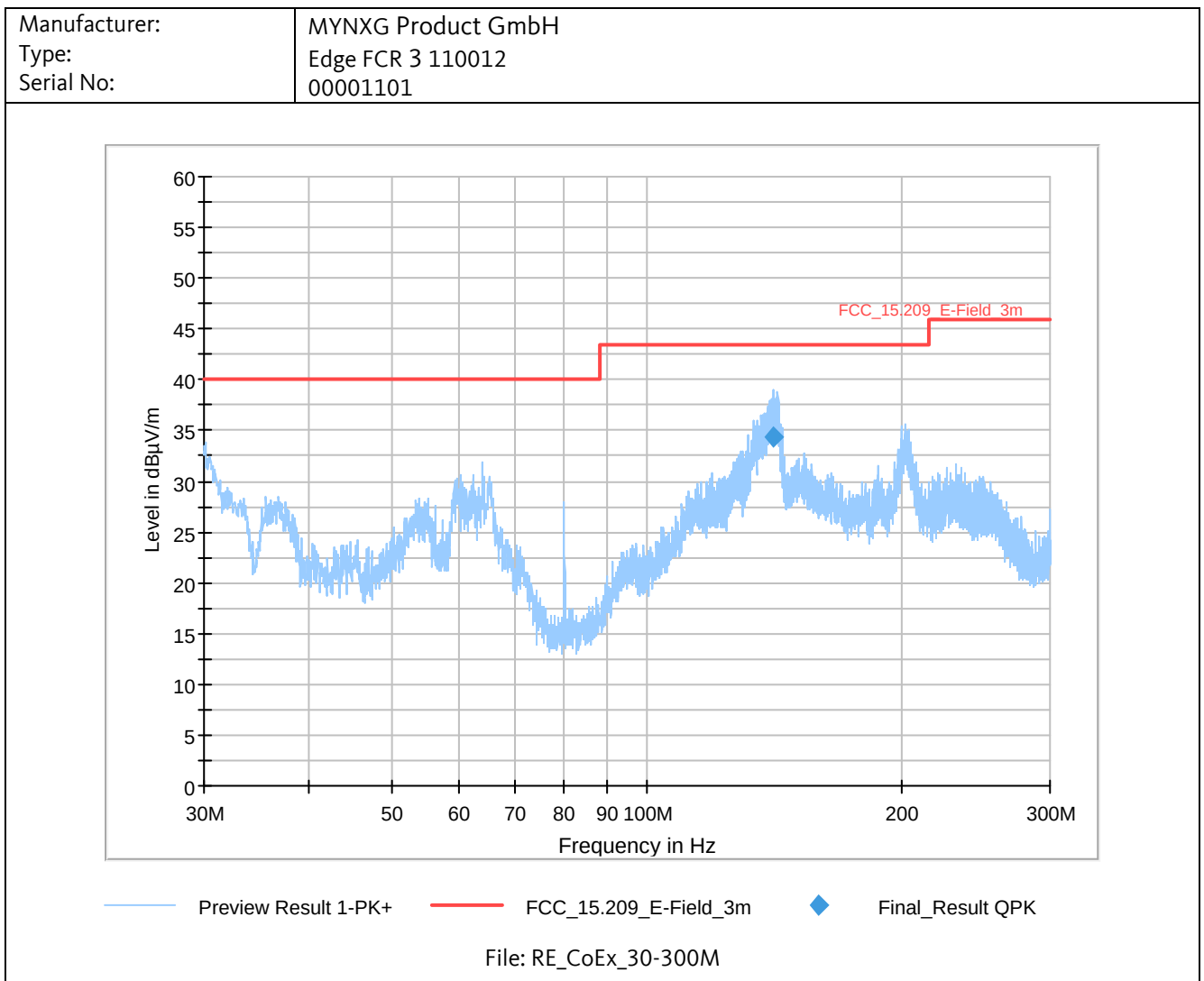
1, 54, 221, 1012, 1048, 1291, 1292,  
1807, 1889, 2128, 2400, 2652, 2666,  
2667, 2724, 2960, 3065, 3203, 3236,  
3846, 3880, 4075, 4717, 5392, 6041,  
6497, 6538



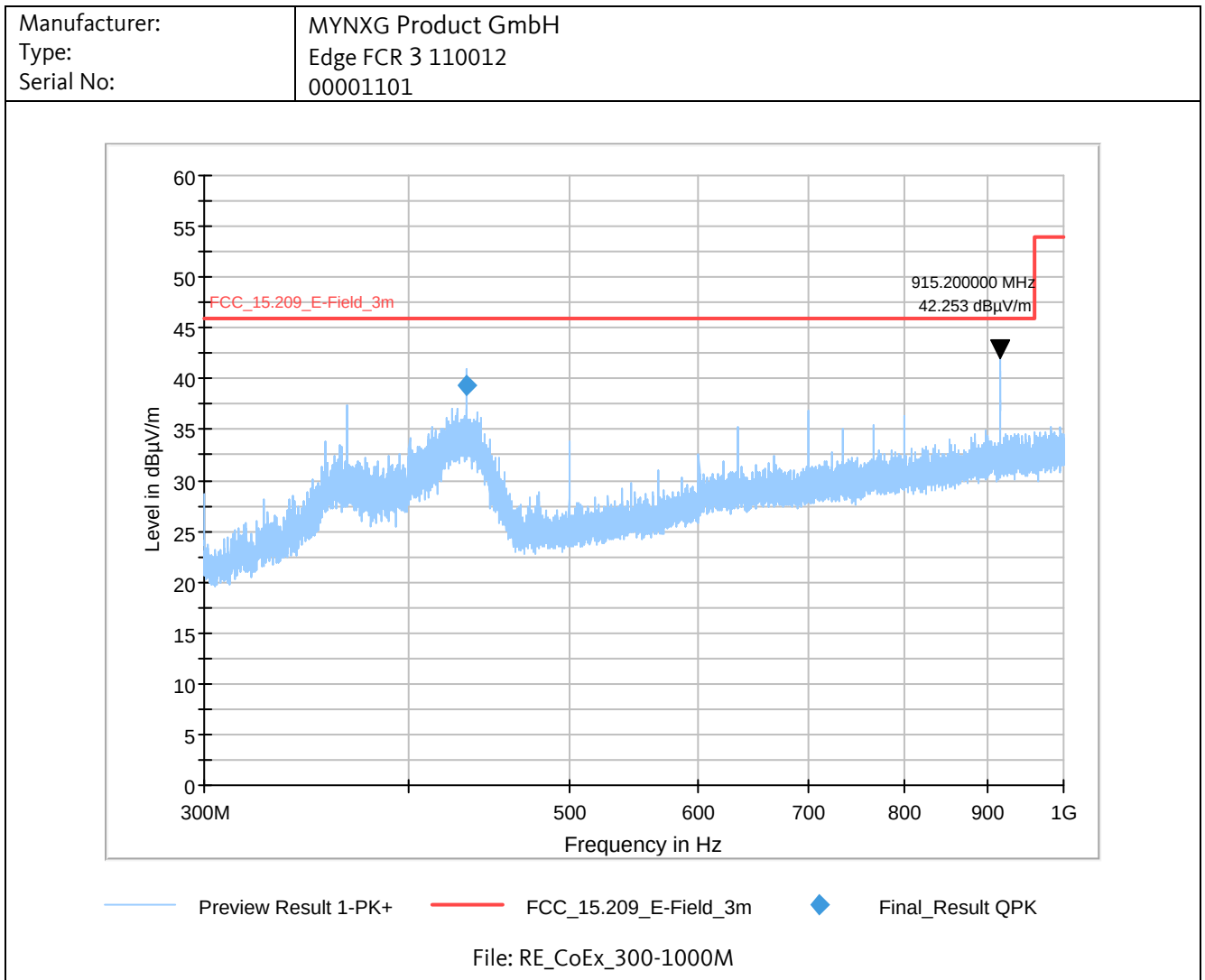
Sample photo of setup

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#### 4.1.4.3 Detailed Test Data



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The carrier of the ISM radio was attenuated by a notch filter.

#### Final Result:

| Frequency<br>MHz | QuasiPeak<br>dBµV/m | Limit<br>dBµV/m | Margin<br>dB | Meas. Time<br>ms | Bandwidth<br>Hz | Height<br>cm | Pol<br>-- | Azimuth<br>deg | Corr.<br>dB/m |
|------------------|---------------------|-----------------|--------------|------------------|-----------------|--------------|-----------|----------------|---------------|
| 141.14           | 34.4                | 43.5            | 9.1          | 1000             | 120.0           | 103.0        | V         | -101           | 13.7          |
| 433.38           | 39.3                | 46.0            | 6.8          | 1000             | 120.0           | 122.0        | V         | -105           | 23.2          |

The table above contains worst-case emissions, only. For further details refer to the pre-scan test plot above.

#### 4.1.4.4 Test Result

Manufacturer: MYNXG Product GmbH  
Type: 110012  
Serial No.: 00001101  
Test date: 2019-08-01  
Test personnel: Patrick Reusch

**The EUT meets the requirements of this section.**

## 4.1.5 Radiated Emissions 1 – 6 GHz

### 4.1.5.1 Test Procedures

#### **ANSI C63.10-2013, 6.6.4.1 General**

Subclauses 6.6.4.2 and 6.6.4.3 describe the procedures that shall be used for making exploratory and final radiated emission tests for frequencies above 1 GHz. Measurements may be performed at a distance closer than that specified in the requirements; however, an attempt shall be made to avoid making measurements in the near field of both the measurement antenna and the EUT for final measurements.

In performing these measurements, the sensitivity of the complete measurement system relative to the limit shall be determined before the test. If the overall measurement sensitivity does not provide a noise floor more than 6 dB below the limit, then low-noise preamplifiers, closer test distances, higher gain antennas, or narrower bandwidths might be required. If closer measurement distances are used, then the beamwidth of the measurement antenna versus the size of the EUT shall be taken into account. Also, measurement system overload protection shall be determined to be adequate when preamplifiers are used [see item b) of 4.1.3]. The effects of using bandwidths different from those specified shall also be determined (see also 6.3). Any changes from the specific measurement conditions shall be described in the report of the measurements (see also Annex E).

Install an appropriate filter at the input of the measurement system power amplifier. This filter shall attenuate the fundamental emission of the EUT and allow an accurate measurement of the associated harmonics and spurious emissions. The filter shall be characterized, and any attenuation/loss factors shall be accounted for in the measurement results.

Data shall be recorded in peak and average detection up to the highest measurement frequency required (unless stated otherwise in the applicable requirements).

#### **ANSI C63.10-2013, 6.6.4.2 Exploratory radiated emissions measurements**

Exploratory radiated measurements shall be performed at the measurement distance or at a closer distance than that specified for compliance to determine the emission characteristics of the EUT and, if applicable, the EUT configuration that produces the maximum level of emissions. The frequencies of maximum emission may be determined by manually positioning the antenna close to the EUT, and then moving the antenna over all sides of the EUT while observing a spectral display. It is advantageous to have prior knowledge of the frequencies of emissions, although this may be determined from such a near-field scan. The near-field scan shall only be used to determine the frequency but not the amplitude of the emissions. Where exploratory measurements are not adequate to determine the worst-case operating modes and are used only to identify the frequencies of the highest emissions, additional preliminary tests can be required.

Preliminary tests shall be performed following the procedures in 6.3 on a site meeting the requirements of 5.2. For emissions from the EUT, the maximum level shall be determined by rotating the EUT and its antenna through 0° to 360°. For each mode of operation required to be tested, the frequency spectrum (based on findings from exploratory measurements) shall be monitored.

Broadband antennas and a spectrum analyzer or a radio-noise meter with a panoramic display are often useful in this type of test. If either antenna height or EUT azimuth are not fully measured during exploratory testing, then complete testing can be required at the OATS or semi-anechoic chamber when the final full spectrum testing is performed.

#### **ANSI C63.10-2013, 6.6.4.3 Final radiated emissions measurements**

The final measurements are performed on a site meeting the requirements of 5.2. Using the orientation and equipment arrangement of the EUT based on the measurement results found during the preliminary (exploratory) measurements per 6.6.4.2, the EUT arrangement, appropriate modulation, and modes of operation that produce the emissions that have the highest amplitude relative to the limit shall be selected for the final measurement. The final measurement shall follow all the procedures in 6.3 with the EUT operating on frequencies per 5.6. For each mode selected, record the frequency and amplitude of the highest fundamental emission (if applicable), as well as the frequency and amplitude of the six highest spurious emissions relative to the limit. Emissions more than 20 dB below the limit do not need to be reported.

Measurements are performed with the EUT rotated from 0° to 360°; the antenna height scanned in accordance with 6.6.3.1, 6.6.3.2, or 6.6.3.3, as appropriate; and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. Variations in cable or wire placement shall be explored to maximize the measured emissions.

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The emission signal shall be kept within the illumination area of the 3 dB beamwidth of the antenna so that the maximum emission from the EUT is measured. This may be achieved by either pointing the antenna at an angle toward the source of the emission or by testing the EUT as described in 6.6.3.3.

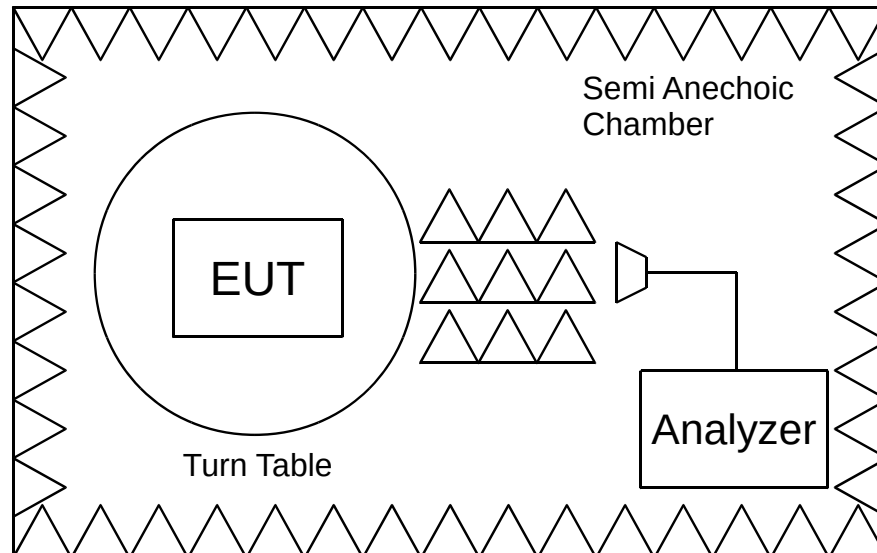
If the emission is pulsed, then refer to Annex C for guidelines on selecting bandwidth and determining pulse desensitization factors, as necessary.

As noted in 6.6.4.1, when performing these measurements, the sensitivity of the complete measurement system relative to the limit shall be determined before the test. If the overall measurement sensitivity is inadequate, then low-noise preamplifiers, closer measurement distances, higher gain antennas, or narrower bandwidths may be used. If closer measurement distances or higher gain antennas are used, then the beamwidth of the measurement antenna versus the physical size of the EUT shall be taken into account, so that the physical sizes of the EUT dimensions are encompassed by the beamwidth of the measurement antenna. Also, measurement system overload protection shall be determined to be adequate when preamplifiers are used. The effects on the measured emission value using bandwidths different from those specified shall be determined if such bandwidth changes are made. Any changes from the specific measurement conditions shall be described in the report of the measurements.

Unless specified otherwise by the regulatory authority, the instrumentation, detector functions, and bandwidths specified in 4.1.4.2.1 and 4.1.4.2.2 shall be used. For pulsed emissions, the procedure in 4.1.4.2.4 shall be used.

| Radiated Emissions Test Characteristics   |                                                               |
|-------------------------------------------|---------------------------------------------------------------|
| Frequency range                           | 1 GHz – 6 GHz                                                 |
| Test distance                             | 3 m                                                           |
| EUT height                                | 1.5 m                                                         |
| Test instrumentation resolution bandwidth | 1 MHz                                                         |
| Receive antenna height                    | 1 m – 4 m                                                     |
| Receive antenna polarization              | Vertical/Horizontal                                           |
| Measurement chamber                       | Semi anechoic chamber (SAC)<br>with rf absorbers on the floor |

#### 4.1.5.2 Test Setup



SCHEMATIC TEST SETUP

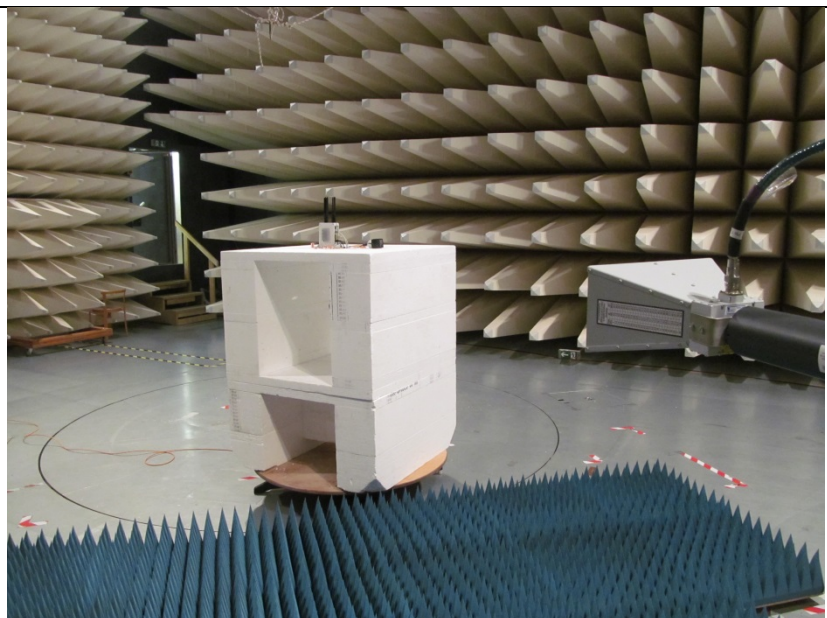
Requirement: 47 CFR, § 15.209  
Procedure: ANSI C63.10-2013  
KDB 996369 D04 v01

Test distance: 3 m  
EUT height: 1.5 m

##### TEST EQUIPMENT USED:

Refer to chapter 5 of this document.

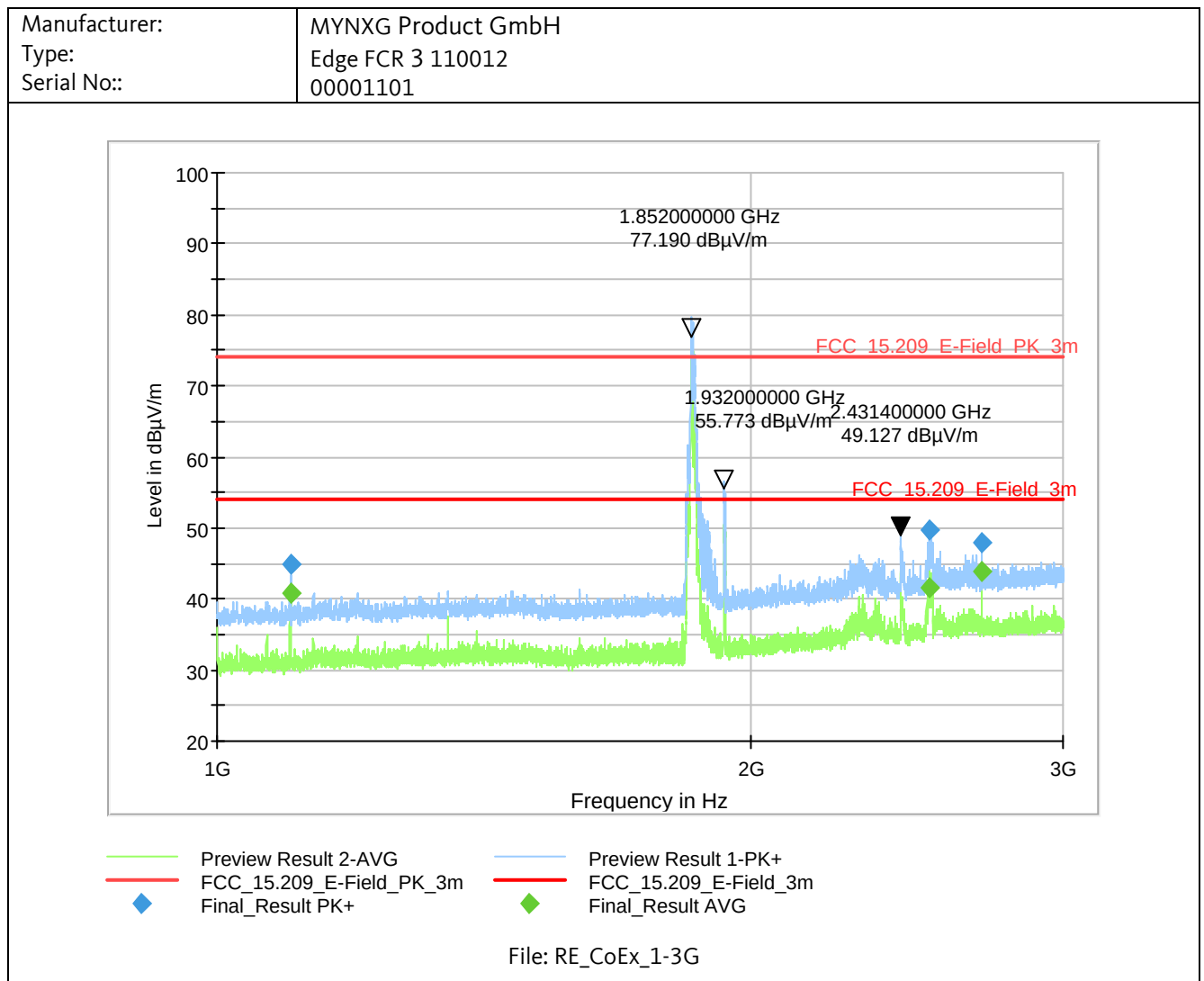
1, 221, 1037, 1043, 1808, 1889,  
2128, 2400, 2652, 2666, 2667, 2960,  
3065, 3203, 3235, 3236, 3831, 3880,  
4075, 4717, 4993, 5366, 5392, 5535,  
5536, 5544, 5545, 5616, 6497, 6538



Sample photo of setup

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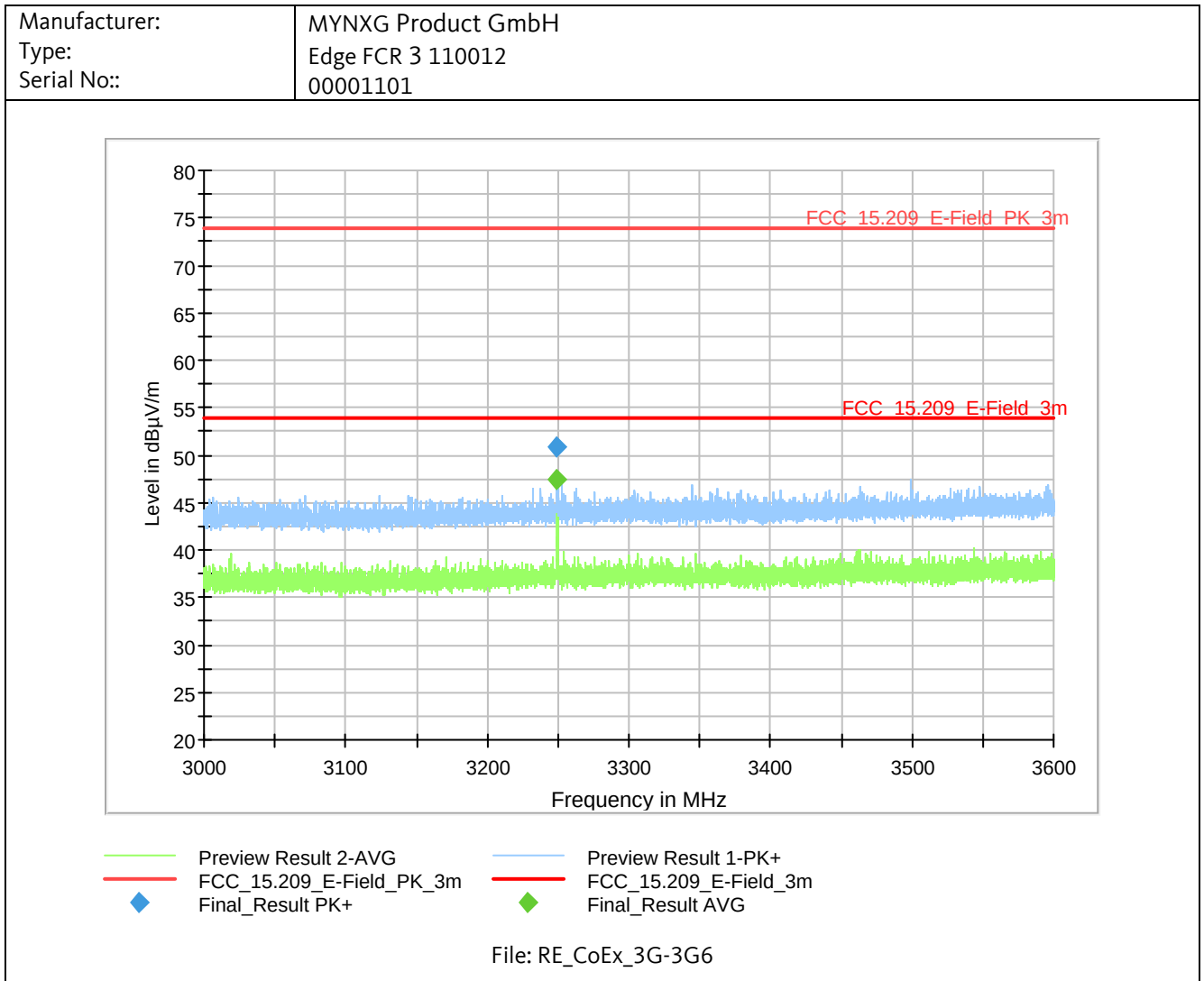
### 4.1.5.3 Detailed Test Data



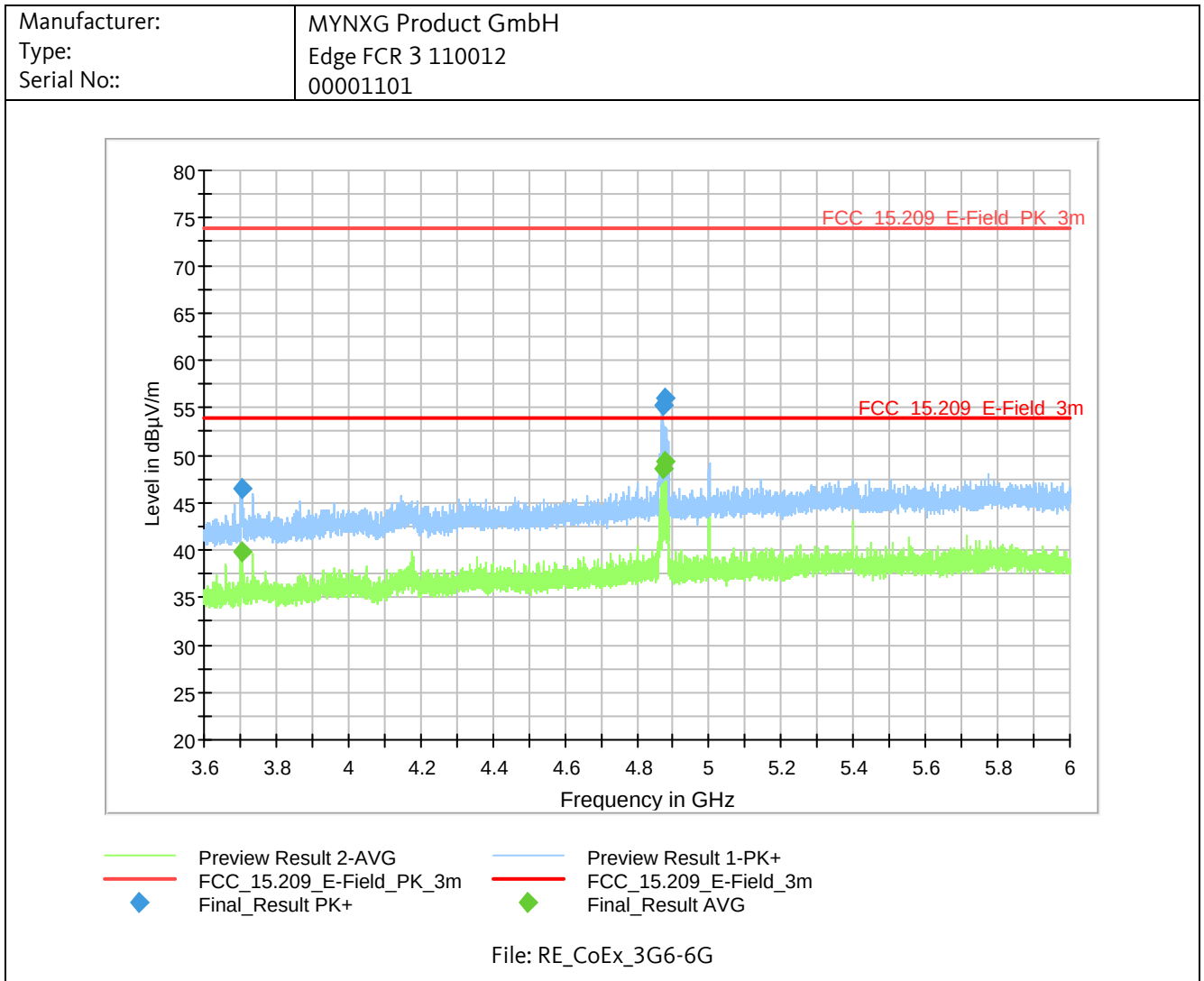
The carrier of the UMTS (1852 MHz) and WIFI (2432 MHz) radios were attenuated by notch filters. The emission at 1932 MHz is the downlink of the UMTS from the communication tester.



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### Final Result:

| Frequency<br>MHz | MaxPeak<br>dB $\mu$ V/m | Average<br>dB $\mu$ V/m | Limit<br>dB $\mu$ V/m | Margin<br>dB | Meas. Time<br>ms | Bandwidth<br>Hz | Height<br>cm | Pol<br>-- | Azimuth<br>deg | Corr.<br>dB/m |
|------------------|-------------------------|-------------------------|-----------------------|--------------|------------------|-----------------|--------------|-----------|----------------|---------------|
| 1099.96          | ---                     | 40.8                    | 54.0                  | 13.2         | 100              | 1000.0          | 173.0        | V         | 6              | 25.9          |
| 1099.96          | 44.9                    | ---                     | 74.0                  | 29.1         | 100              | 1000.0          | 173.0        | V         | 6              | 25.9          |
| 2521.98          | ---                     | 41.5                    | 54.0                  | 12.5         | 100              | 1000.0          | 204.0        | V         | 61             | 29.2          |
| 2521.98          | 49.7                    | ---                     | 74.0                  | 24.3         | 100              | 1000.0          | 204.0        | V         | 61             | 29.2          |
| 2699.99          | ---                     | 43.8                    | 54.0                  | 10.2         | 100              | 1000.0          | 266.0        | H         | 289            | 29.6          |
| 2699.99          | 48.0                    | ---                     | 74.0                  | 26.1         | 100              | 1000.0          | 266.0        | H         | 289            | 29.6          |
| 3249.29          | ---                     | 47.5                    | 54.0                  | 6.5          | 100              | 1000.0          | 150.0        | H         | 161            | 30.6          |
| 3249.29          | 50.9                    | ---                     | 74.0                  | 23.1         | 100              | 1000.0          | 150.0        | H         | 161            | 30.6          |
| 3703.21          | ---                     | 39.9                    | 54.0                  | 14.1         | 100              | 1000.0          | 150.0        | H         | 81             | 31.3          |
| 3703.21          | 46.4                    | ---                     | 74.0                  | 27.6         | 100              | 1000.0          | 150.0        | H         | 81             | 31.3          |
| 4870.50          | 55.3                    | ---                     | 74.0                  | 18.7         | 100              | 1000.0          | 410.0        | H         | 250            | 33.9          |
| 4870.50          | ---                     | 48.6                    | 54.0                  | 5.4          | 100              | 1000.0          | 410.0        | H         | 250            | 33.9          |
| 4880.08          | 56.0                    | ---                     | 74.0                  | 18.0         | 100              | 1000.0          | 284.0        | H         | 124            | 33.9          |
| 4880.08          | ---                     | 49.3                    | 54.0                  | 4.7          | 100              | 1000.0          | 284.0        | H         | 124            | 33.9          |

The table above contains worst-case emissions, only. For further details refer to the pre-scan test plot above.

#### **4.1.5.4 Test Result**

|                 |                    |
|-----------------|--------------------|
| Manufacturer:   | MYNXG Product GmbH |
| Type:           | 110012             |
| Serial No.:     | 00001101           |
| Test date:      | 2019-08-01         |
| Test personnel: | Patrick Reusch     |

**The EUT meets the requirements of this section.**

## 4.1.6 Radiated Emissions 6 – 18 GHz

### 4.1.6.1 Test Procedures

#### **ANSI C63.10-2013, 6.6.4.1 General**

Subclauses 6.6.4.2 and 6.6.4.3 describe the procedures that shall be used for making exploratory and final radiated emission tests for frequencies above 1 GHz. Measurements may be performed at a distance closer than that specified in the requirements; however, an attempt shall be made to avoid making measurements in the near field of both the measurement antenna and the EUT for final measurements.

In performing these measurements, the sensitivity of the complete measurement system relative to the limit shall be determined before the test. If the overall measurement sensitivity does not provide a noise floor more than 6 dB below the limit, then low-noise preamplifiers, closer test distances, higher gain antennas, or narrower bandwidths might be required. If closer measurement distances are used, then the beamwidth of the measurement antenna versus the size of the EUT shall be taken into account. Also, measurement system overload protection shall be determined to be adequate when preamplifiers are used [see item b) of 4.1.3]. The effects of using bandwidths different from those specified shall also be determined (see also 6.3). Any changes from the specific measurement conditions shall be described in the report of the measurements (see also Annex E).

Install an appropriate filter at the input of the measurement system power amplifier. This filter shall attenuate the fundamental emission of the EUT and allow an accurate measurement of the associated harmonics and spurious emissions. The filter shall be characterized, and any attenuation/loss factors shall be accounted for in the measurement results.

Data shall be recorded in peak and average detection up to the highest measurement frequency required (unless stated otherwise in the applicable requirements).

#### **ANSI C63.10-2013, 6.6.4.2 Exploratory radiated emissions measurements**

Exploratory radiated measurements shall be performed at the measurement distance or at a closer distance than that specified for compliance to determine the emission characteristics of the EUT and, if applicable, the EUT configuration that produces the maximum level of emissions. The frequencies of maximum emission may be determined by manually positioning the antenna close to the EUT, and then moving the antenna over all sides of the EUT while observing a spectral display. It is advantageous to have prior knowledge of the frequencies of emissions, although this may be determined from such a near-field scan. The near-field scan shall only be used to determine the frequency but not the amplitude of the emissions. Where exploratory measurements are not adequate to determine the worst-case operating modes and are used only to identify the frequencies of the highest emissions, additional preliminary tests can be required.

Preliminary tests shall be performed following the procedures in 6.3 on a site meeting the requirements of 5.2. For emissions from the EUT, the maximum level shall be determined by rotating the EUT and its antenna through 0° to 360°. For each mode of operation required to be tested, the frequency spectrum (based on findings from exploratory measurements) shall be monitored.

Broadband antennas and a spectrum analyzer or a radio-noise meter with a panoramic display are often useful in this type of test. If either antenna height or EUT azimuth are not fully measured during exploratory testing, then complete testing can be required at the OATS or semi-anechoic chamber when the final full spectrum testing is performed.

#### **ANSI C63.10-2013, 6.6.4.3 Final radiated emissions measurements**

The final measurements are performed on a site meeting the requirements of 5.2. Using the orientation and equipment arrangement of the EUT based on the measurement results found during the preliminary (exploratory) measurements per 6.6.4.2, the EUT arrangement, appropriate modulation, and modes of operation that produce the emissions that have the highest amplitude relative to the limit shall be selected for the final measurement. The final measurement shall follow all the procedures in 6.3 with the EUT operating on frequencies per 5.6. For each mode selected, record the frequency and amplitude of the highest fundamental emission (if applicable), as well as the frequency and amplitude of the six highest spurious emissions relative to the limit. Emissions more than 20 dB below the limit do not need to be reported.

Measurements are performed with the EUT rotated from 0° to 360°; the antenna height scanned in accordance with 6.6.3.1, 6.6.3.2, or 6.6.3.3, as appropriate; and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. Variations in cable or wire placement shall be explored to maximize the measured emissions.

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The emission signal shall be kept within the illumination area of the 3 dB beamwidth of the antenna so that the maximum emission from the EUT is measured. This may be achieved by either pointing the antenna at an angle toward the source of the emission or by testing the EUT as described in 6.6.3.3.

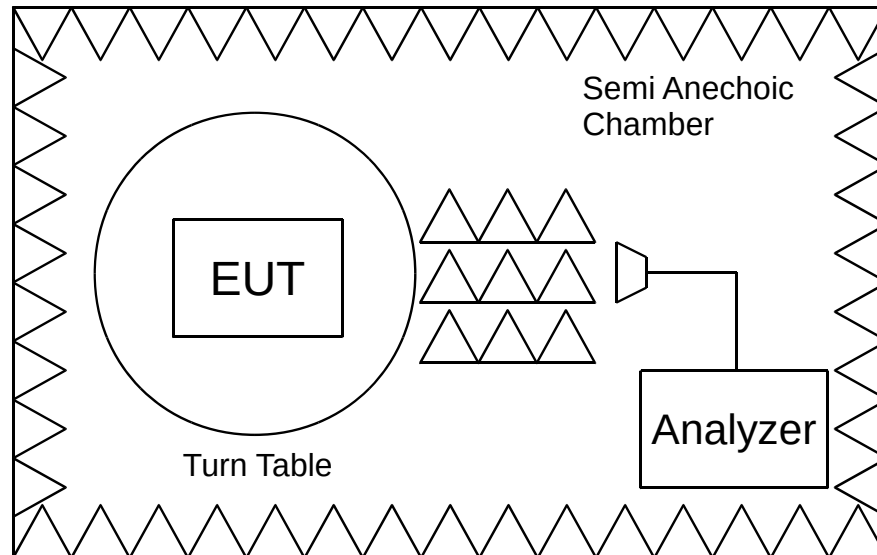
If the emission is pulsed, then refer to Annex C for guidelines on selecting bandwidth and determining pulse desensitization factors, as necessary.

As noted in 6.6.4.1, when performing these measurements, the sensitivity of the complete measurement system relative to the limit shall be determined before the test. If the overall measurement sensitivity is inadequate, then low-noise preamplifiers, closer measurement distances, higher gain antennas, or narrower bandwidths may be used. If closer measurement distances or higher gain antennas are used, then the beamwidth of the measurement antenna versus the physical size of the EUT shall be taken into account, so that the physical sizes of the EUT dimensions are encompassed by the beamwidth of the measurement antenna. Also, measurement system overload protection shall be determined to be adequate when preamplifiers are used. The effects on the measured emission value using bandwidths different from those specified shall be determined if such bandwidth changes are made. Any changes from the specific measurement conditions shall be described in the report of the measurements.

Unless specified otherwise by the regulatory authority, the instrumentation, detector functions, and bandwidths specified in 4.1.4.2.1 and 4.1.4.2.2 shall be used. For pulsed emissions, the procedure in 4.1.4.2.4 shall be used.

| Radiated Emissions Test Characteristics   |                                                               |
|-------------------------------------------|---------------------------------------------------------------|
| Frequency range                           | 6 GHz – 18 GHz                                                |
| Test distance                             | 1 m                                                           |
| EUT height                                | 1.5 m                                                         |
| Test instrumentation resolution bandwidth | 1 MHz                                                         |
| Receive antenna height                    | 1 m – 2 m                                                     |
| Receive antenna polarization              | Vertical/Horizontal                                           |
| Measurement chamber                       | Semi anechoic chamber (SAC)<br>with rf absorbers on the floor |

#### 4.1.6.2 Test Setup

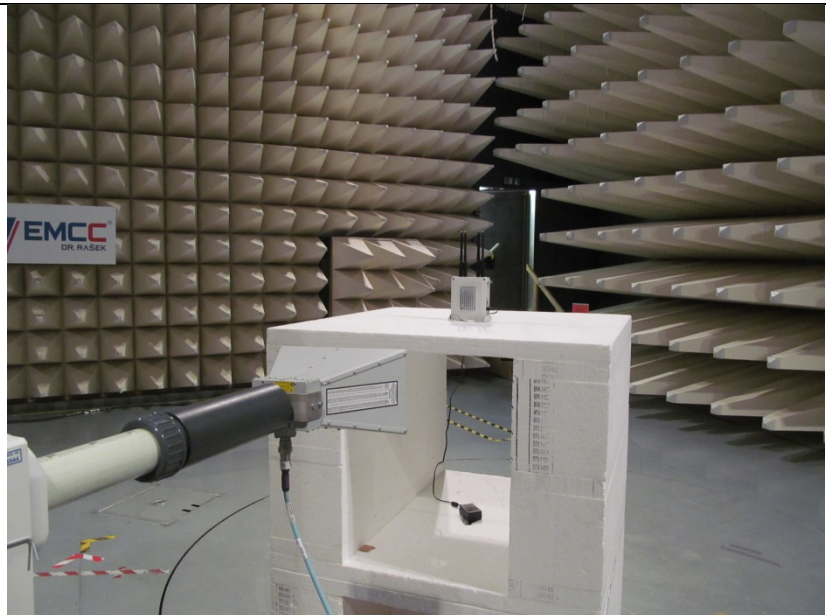


SCHEMATIC TEST SETUP

Requirement: 47 CFR, § 15.209  
Procedure: ANSI C63.10-2013  
KDB 996369 D04 v01

Test distance: 1 m  
EUT height: 1.5 m

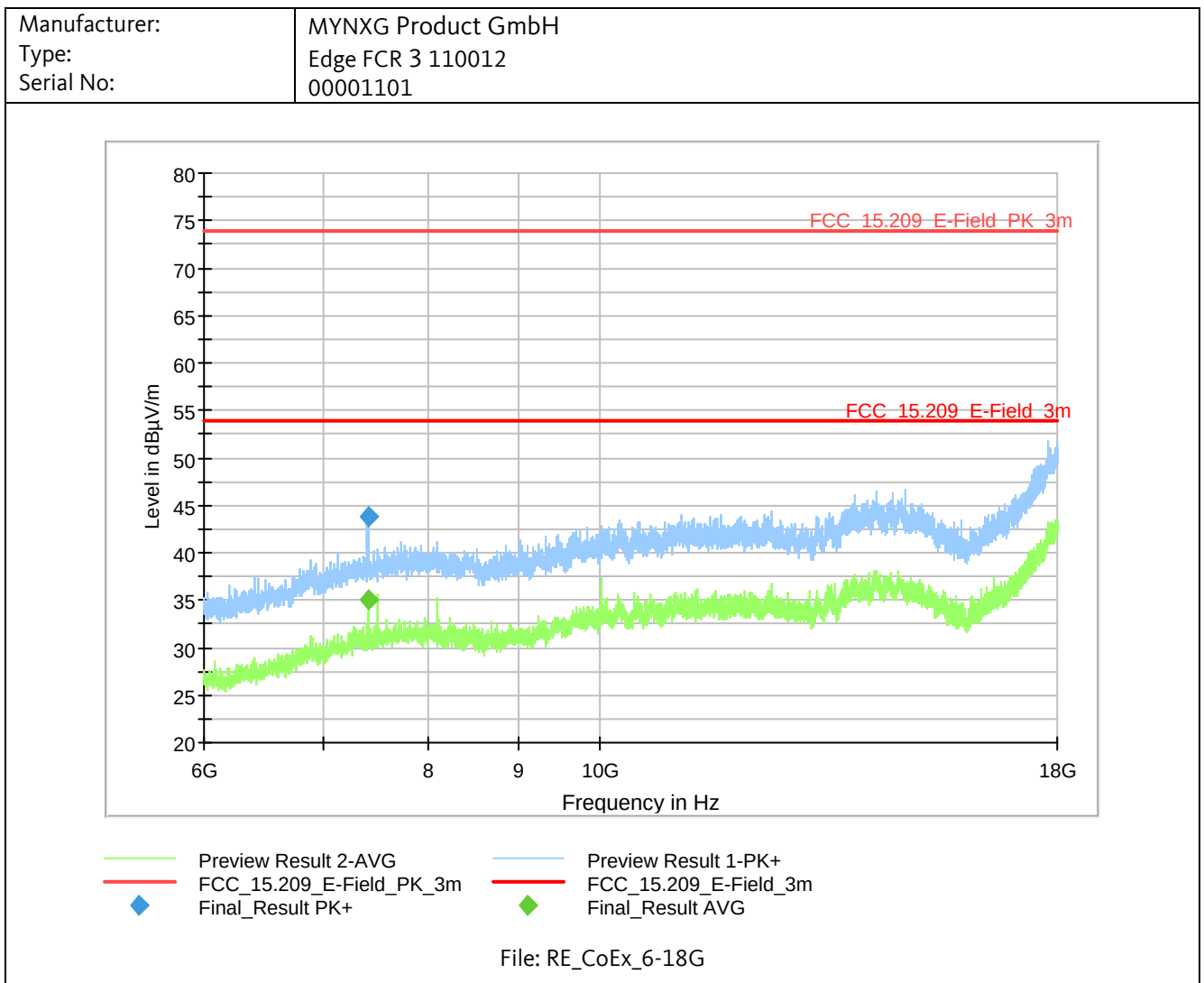
TEST EQUIPMENT USED:  
Refer to chapter 5 of this document.  
1, 221, 1889, 2128, 2400, 2652,  
2666, 2667, 2960, 3065, 3203, 3235,  
3236, 3831, 3880, 4075, 4717, 5366,  
5392, 5535, 5536, 5544, 5545, 5620,  
6497, 6538



Sample photo of setup

## Test on MYNXG Product GmbH Edge FCR 3 to KDB 996369 D04 Module Integration Guide v01

### 4.1.6.3 Detailed Test Data



All tests performed at the distance of 1 m. The measurement value was adjusted to correspond with the 3 m limit.

#### Final Result:

| Frequency<br>MHz | MaxPeak<br>dBμV/m | Average<br>dBμV/m | Limit<br>dBμV/m | Margin<br>dB | Meas. Time<br>ms | Bandwidth<br>Hz | Height<br>cm | Pol<br>-- | Azimuth<br>deg | Corr.<br>dB/m |
|------------------|-------------------|-------------------|-----------------|--------------|------------------|-----------------|--------------|-----------|----------------|---------------|
| 7413.81          | ---               | 35.1              | 54.0            | 18.9         | 100              | 1000.0          | 176.0        | V         | 300            | 27.7          |
| 7413.81          | 43.9              | ---               | 74.0            | 30.1         | 100              | 1000.0          | 176.0        | V         | 300            | 27.7          |

All tests performed at the distance of 1 m. The measurement value was adjusted to correspond with the 3 m limit.

The table above contains worst-case emissions, only. For further details refer to the pre-scan test plot above.

#### **4.1.6.4 Test Result**

|                 |                    |
|-----------------|--------------------|
| Manufacturer:   | MYNXG Product GmbH |
| Type:           | 110012             |
| Serial No.:     | 00001101           |
| Test date:      | 2019-08-01         |
| Test personnel: | Patrick Reusch     |

**The EUT meets the requirements of this section.**



## 4.2 Field Strength of Fundamental

### 4.2.1 Regulation

The following parameters were defined by test plan:

The fundamental power of the radio modules, which are not tested in the host product, shall determined by radiated measurement following the procedures in ANSI C63.10-2013

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##### 3.0 HOST PRODUCT TESTING GUIDANCE

###### 3.1 General

Testing of the host product with all the transmitters installed is recommended, to verify that the host product meets all the applicable FCC rules. The radio spectrum is to be investigated with all the transmitters in the final host product functioning to determine that no emissions exceed the highest limit permitted for any one individual transmitter as required by Section 2.947(f). A formal application for certification submission containing the results of this investigation is not required. The host manufacturer is responsible to ensure that when their product operates as intended it does not have any emissions present that are out of compliance that were not present when the transmitters were tested individually.

The following provides general guidance and suggestions to host product manufacturers when installing a certified modular transmitter, on how they may verify the intentional radiator (transmitter) compliance of the composite-system end product.

- a) If the modular transmitter has been fully tested by the module grantee on the required number of channels, modulation types, and modes, it should not be necessary for the host installer to re-test all the available transmitter modes or settings. It is recommended that the host product manufacturer, installing the modular transmitter, perform some investigative measurements to confirm that the resulting composite system does not exceed the spurious emissions limits or band edge limits (e.g., where a different antenna may be causing additional emissions).
- b) The testing should check for emissions that may occur due to the intermixing of emissions with the other transmitters, digital circuitry, or due to physical properties of the host product (enclosure). This investigation is especially important when integrating multiple modular transmitters where the certification is based on testing each of them in a stand-alone configuration. It is important to note that host product manufacturers should not assume that because the modular transmitter is certified that they do not have any responsibility for final product compliance.
- c) If the investigation indicates a compliance concern the host product manufacturer is obligated to mitigate the issue. Host products using a modular transmitter are subject to all the applicable individual technical rules as well as to the general conditions of operation in Sections 15.5, 15.15, and 15.29 to not cause interference. The operator of the host product will be obligated to stop operating the device until the interference has been corrected.

###### 3.2 Frequency spectrum to be investigated

For host products with certified modular transmitter, the frequency range of investigation of the composite system is specified by rule in Sections 15.33(a)(1) through (a)(3), or the range applicable to the digital device, as shown in Section 15.33(b)(1), whichever is the higher frequency range of investigation. [...]

###### 3.3 Operating the host product

When testing the host product, all the transmitters must be operating. The transmitters can be enabled by using publicly-available drivers and turned on, so the transmitters are active. In certain conditions it might be appropriate to use a technology-specific call box (test set) where accessory devices or drivers are not available

###### 3.4 Emission measurements

- a) Measure the fundamental and unwanted/spurious emissions with the modular transmitter(s) operating in a normal mode.
- b) Perform testing on unwanted (spurious) radiated emissions on the worst-case modulation and channel per frequency range as shown in original filing.

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- c) Where the transmitter power is based on ERP/EIRP or field strength, the host product manufacturer should ensure that installation of the modular transmitter has not affected the modular transmitter ERP/EIRP or its field strength rating. It should not be necessary to re-test the transmitter output power of any modular transmitter which has been certified based on conducted power.
- d) When power is not listed on the FCC grant, it should be assumed that the limit is based on field strength and that information will be in the associated test report in the modular transmitter application. The host product manufacturer may want to create a matrix based on test results

## 4.2.2 Test Procedures

### ANSI C63.10-2013, 6.6.4.1 General

Subclauses 6.6.4.2 and 6.6.4.3 describe the procedures that shall be used for making exploratory and final radiated emission tests for frequencies above 1 GHz. Measurements may be performed at a distance closer than that specified in the requirements; however, an attempt shall be made to avoid making measurements in the near field of both the measurement antenna and the EUT for final measurements.

In performing these measurements, the sensitivity of the complete measurement system relative to the limit shall be determined before the test. If the overall measurement sensitivity does not provide a noise floor more than 6 dB below the limit, then low-noise preamplifiers, closer test distances, higher gain antennas, or narrower bandwidths might be required. If closer measurement distances are used, then the beamwidth of the measurement antenna versus the size of the EUT shall be taken into account. Also, measurement system overload protection shall be determined to be adequate when preamplifiers are used [see item b) of 4.1.3]. The effects of using bandwidths different from those specified shall also be determined (see also 6.3). Any changes from the specific measurement conditions shall be described in the report of the measurements (see also Annex E).

Install an appropriate filter at the input of the measurement system power amplifier. This filter shall attenuate the fundamental emission of the EUT and allow an accurate measurement of the associated harmonics and spurious emissions. The filter shall be characterized, and any attenuation/loss factors shall be accounted for in the measurement results.

Data shall be recorded in peak and average detection upto the highest measurement frequency required (unless stated otherwise in the applicable requirements).

### ANSI C63.10-2013, 6.6.4.2 Exploratory radiated emissions measurements

Exploratory radiated measurements shall be performed at the measurement distance or at a closer distance than that specified for compliance to determine the emission characteristics of the EUT and, if applicable, the EUT configuration that produces the maximum level of emissions. The frequencies of maximum emission may be determined by manually positioning the antenna close to the EUT, and then moving the antenna over all sides of the EUT while observing a spectral display. It is advantageous to have prior knowledge of the frequencies of emissions, although this may be determined from such a near-field scan. The near-field scan shall only be used to determine the frequency but not the amplitude of the emissions. Where exploratory measurements are not adequate to determine the worst-case operating modes and are used only to identify the frequencies of the highest emissions, additional preliminary tests can be required.

Preliminary tests shall be performed following the procedures in 6.3 on a site meeting the requirements of 5.2. For emissions from the EUT, the maximum level shall be determined by rotating the EUT and its antenna through 0° to 360°. For each mode of operation required to be tested, the frequency spectrum (based on findings from exploratory measurements) shall be monitored.

Broadband antennas and a spectrum analyzer or a radio-noise meter with a panoramic display are often useful in this type of test. If either antenna height or EUT azimuth are not fully measured during exploratory testing, then complete testing can be required at the OATS or semi-anechoic chamber when the final full spectrum testing is performed.

### ANSI C63.10-2013, 6.6.4.3 Final radiated emissions measurements

The final measurements are performed on a site meeting the requirements of 5.2. Using the orientation and equipment arrangement of the EUT based on the measurement results found during the preliminary (exploratory) measurements per 6.6.4.2, the EUT arrangement, appropriate modulation, and modes of operation that produce the emissions that have the highest amplitude relative to the limit shall be selected for the final measurement. The final measurement shall follow all the procedures in 6.3 with the EUT operating on frequencies per 5.6. For each mode selected, record the frequency and amplitude of the highest fundamental emission (if applicable), as well as the frequency and amplitude of

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the six highest spurious emissions relative to the limit. Emissions more than 20 dB below the limit do not need to be reported.

Measurements are performed with the EUT rotated from 0° to 360°; the antenna height scanned in accordance with 6.6.3.1, 6.6.3.2, or 6.6.3.3, as appropriate; and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. Variations in cable or wire placement shall be explored to maximize the measured emissions.

The emission signal shall be kept within the illumination area of the 3 dB beamwidth of the antenna so that the maximum emission from the EUT is measured. This may be achieved by either pointing the antenna at an angle toward the source of the emission or by testing the EUT as described in 6.6.3.3.

If the emission is pulsed, then refer to Annex C for guidelines on selecting bandwidth and determining pulse desensitization factors, as necessary.

As noted in 6.6.4.1, when performing these measurements, the sensitivity of the complete measurement system relative to the limit shall be determined before the test. If the overall measurement sensitivity is inadequate, then low-noise preamplifiers, closer measurement distances, higher gain antennas, or narrower bandwidths may be used. If closer measurement distances or higher gain antennas are used, then the beamwidth of the measurement antenna versus the physical size of the EUT shall be taken into account, so that the physical sizes of the EUT dimensions are encompassed by the beamwidth of the measurement antenna. Also, measurement system overload protection shall be determined to be adequate when preamplifiers are used. The effects on the measured emission value using bandwidths different from those specified shall be determined if such bandwidth changes are made. Any changes from the specific measurement conditions shall be described in the report of the measurements.

Unless specified otherwise by the regulatory authority, the instrumentation, detector functions, and bandwidths specified in 4.1.4.2.1 and 4.1.4.2.2 shall be used. For pulsed emissions, the procedure in 4.1.4.2.4 shall be used.

| Radiated Emissions Test Characteristics   |                                                               |
|-------------------------------------------|---------------------------------------------------------------|
| Frequency range                           | 1852.4 MHz and 2437 MHz                                       |
| Test distance                             | 3 m                                                           |
| EUT height                                | 1.5 m                                                         |
| Test instrumentation resolution bandwidth | RBW > OBW                                                     |
| Receive antenna height                    | 1 m – 4 m                                                     |
| Receive antenna polarization              | Vertical/Horizontal                                           |
| Measurement chamber                       | Semi anechoic chamber (SAC)<br>with rf absorbers on the floor |

### 4.2.3 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF$$

where

FS = Field Strength (in dBμV/m)

RA = Receiver Amplitude (in dBμV or in dBm, where 107 dBμV = 0 dBm)

AF = Antenna Factor (in dB (1/m))

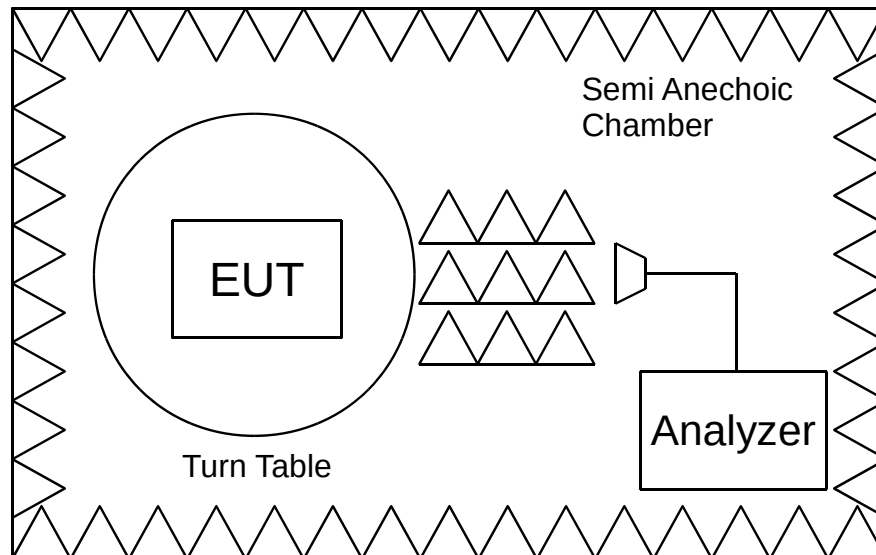
CF = Cable Attenuation Factor (in dB)

Assume a receiver reading of 76.2 dBμV is obtained. The Antenna Factor of 37.2 dB(1/m) and a Cable Factor of 2.7 dB are added, giving a field strength of 116.1 dBμV/m in the measurement distance. The field strength of 116.1 dBμV/m value can be mathematically converted to its corresponding level in μV/m.

$$FS = 76.2 + 37.2 + 2.7 = 116.1$$

$$\text{Level (in } \mu\text{V/m)} = \text{Common Antilogarithm } (116.1/20) = 638 \text{ 263}$$

#### 4.2.4 Test Setup

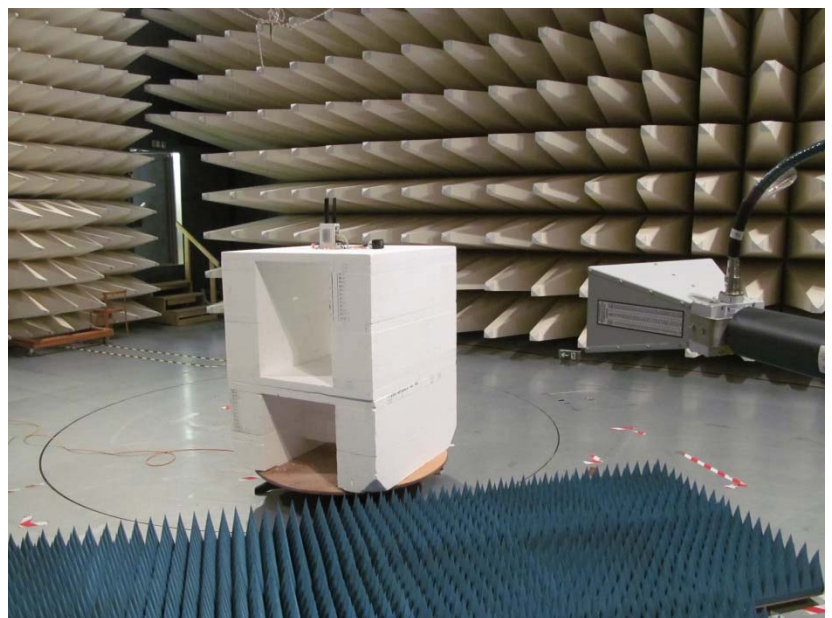


SCHEMATIC TEST SETUP

Requirement: n/a  
Procedure: ANSI C63.10-2013

Test Distance: 3 m  
EUT height: 1.5 m

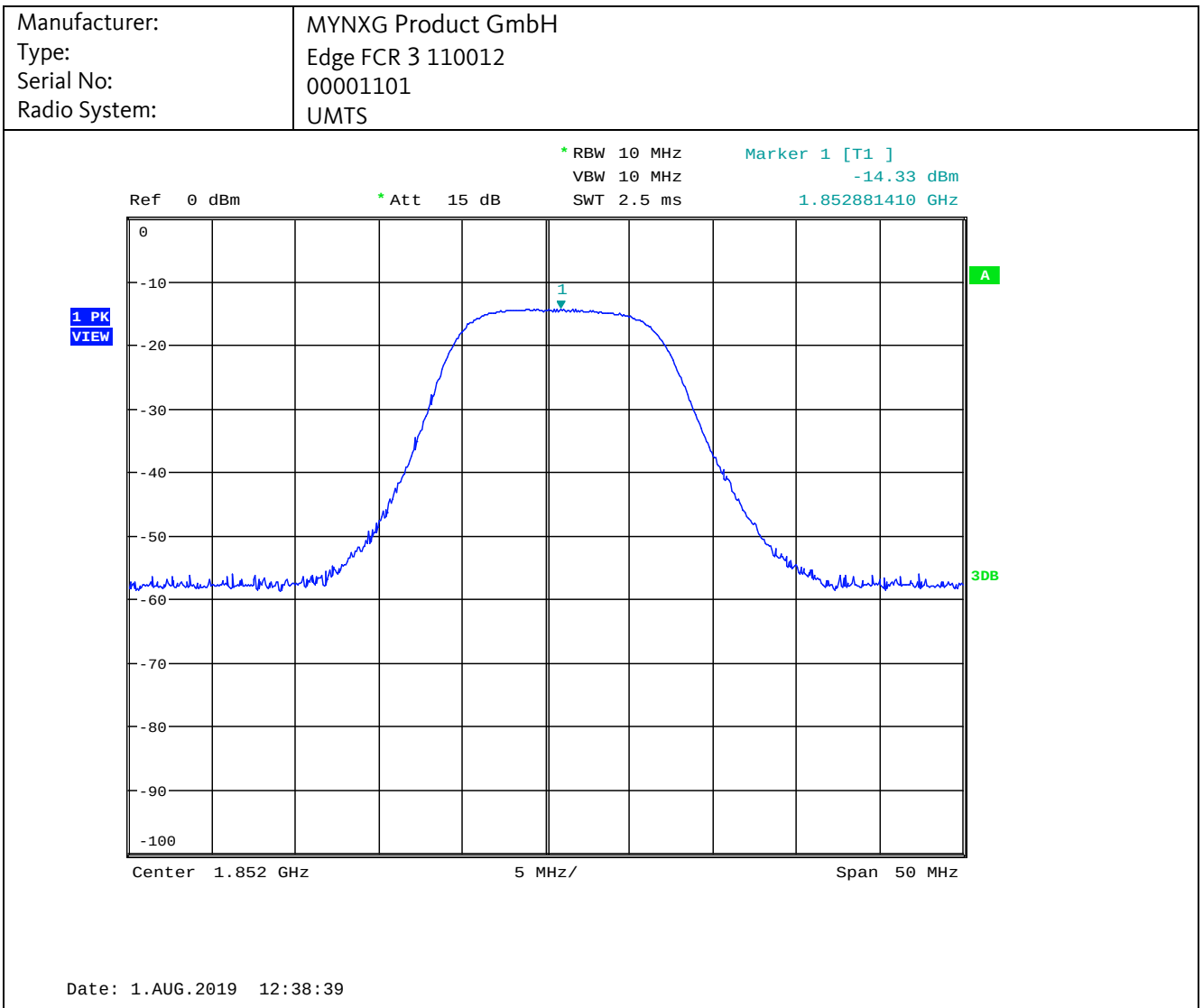
**TEST EQUIPMENT USED:**  
Refer to chapter 5 of this document.  
1, 221, 1889, 2128, 2400, 2652, 2666,  
2667, 2960, 3065, 3203, 3235, 3236,  
3831, 3880, 4075, 4717, 5392, 5535,  
5536, 5544, 5545, 5616, 6497, 6538



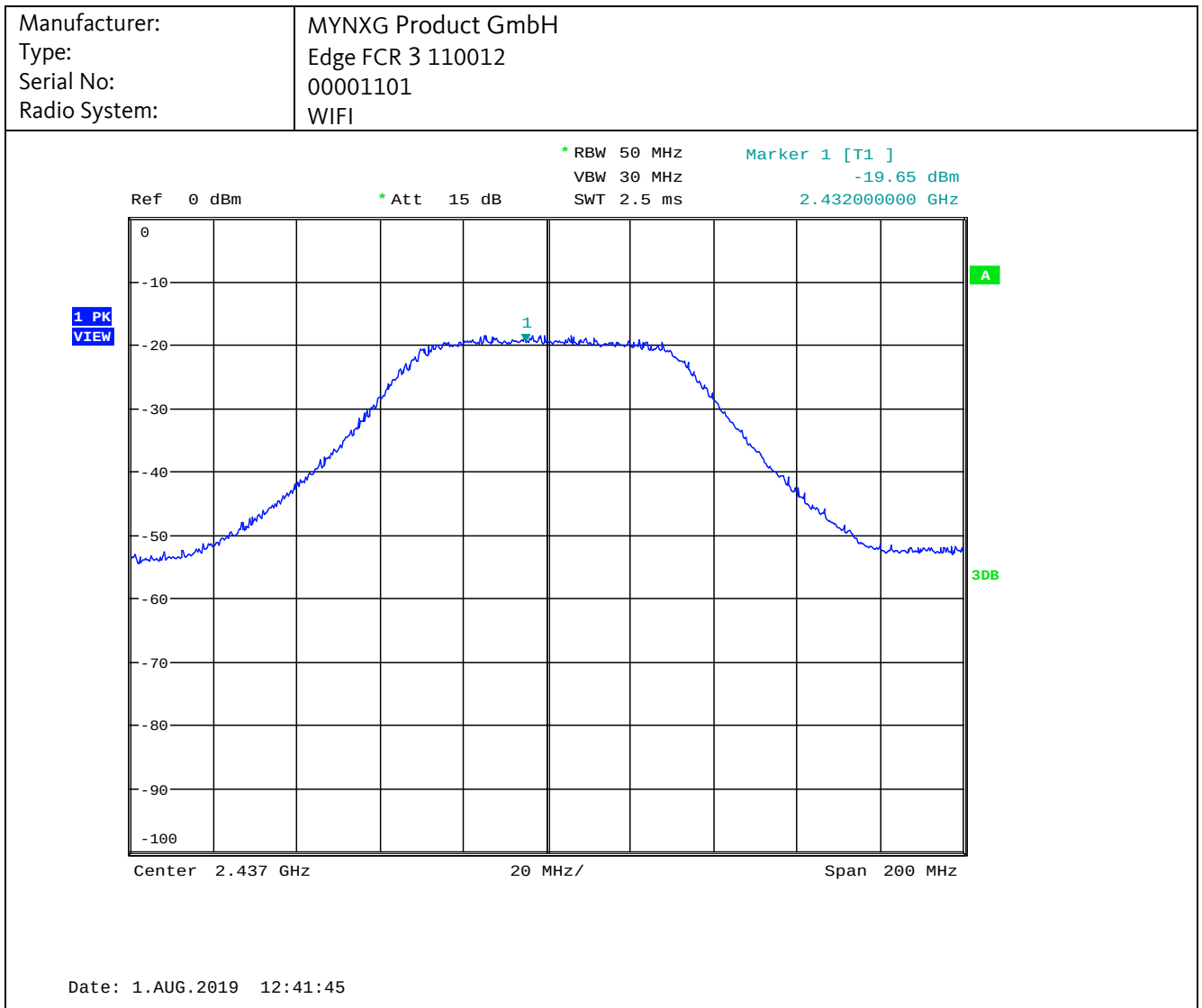
Sample photo of setup

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## 4.2.5 Detailed Test Data



## Test on MYNXG Product GmbH Edge FCR 3 to KDB 996369 D04 Module Integration Guide v01



### Final Result:

| Frequency (MHz) | RA (dBm) | AF (dB) | CF (dB) | Field Strength @ 3m (dBμV/m) | Power E.I.R.P (dBm) |
|-----------------|----------|---------|---------|------------------------------|---------------------|
| 1852.4          | -14.3    | 25.4    | 1.3     | 119.4                        | 24.2                |
| 2437.0          | -19.6    | 27.5    | 1.6     | 116.4                        | 21.2                |

Calculation of E.I.R.P.:

$$\text{EIRP}_{\text{dBm}} = E_{\text{dB}\mu\text{V/m}} - 104.77 + 20 \log D_{\text{test}}$$

#### **4.2.6 Test Result**

|                 |                    |
|-----------------|--------------------|
| Manufacturer:   | MYNXG Product GmbH |
| Type:           | 110012             |
| Serial No.:     | 00001101           |
| Test date:      | 2019-08-01         |
| Test personnel: | Patrick Reusch     |

## 4.3 Exposure Evaluation

Test Requirement: 47 CFR, § 1.1310

### 4.3.1 Regulation

#### 47 CFR, § 1.1310:

The criteria listed in table 1 shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in § 1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of § 2.1093 of this chapter.

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

| Frequency range (MHz)                                          | Electric field strength (V/m) | Magnetic field strength (A/m) | Power density (mW/cm <sup>2</sup> ) | Averaging time (minutes) |
|----------------------------------------------------------------|-------------------------------|-------------------------------|-------------------------------------|--------------------------|
| <b>(A) Limits for Occupational/Controlled Exposures</b>        |                               |                               |                                     |                          |
| 0.3–3.0 .....                                                  | 614                           | 1.63                          | *(100)                              | 6                        |
| 3.0–30 .....                                                   | 1842/f                        | 4.89/f                        | *(900/f <sup>2</sup> )              | 6                        |
| 30–300 .....                                                   | 61.4                          | 0.163                         | 1.0                                 | 6                        |
| 300–1500 .....                                                 | .....                         | .....                         | f/300                               | 6                        |
| 1500–100,000 .....                                             | .....                         | .....                         | 5                                   | 6                        |
| <b>(B) Limits for General Population/Uncontrolled Exposure</b> |                               |                               |                                     |                          |
| 0.3–1.34 .....                                                 | 614                           | 1.63                          | *(100)                              | 30                       |
| 1.34–30 .....                                                  | 824/f                         | 2.19/f                        | *(180/f <sup>2</sup> )              | 30                       |
| 30–300 .....                                                   | 27.5                          | 0.073                         | 0.2                                 | 30                       |
| 300–1500 .....                                                 | .....                         | .....                         | f/1500                              | 30                       |
| 1500–100,000 .....                                             | .....                         | .....                         | 1.0                                 | 30                       |

f = frequency in MHz

\* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

### 4.3.2 Calculation

#### MPE based on far-field assumption

Power density calculates as

$$P_d = (P \times G) / (4 \times \pi \times d^2)$$

Where

P<sub>d</sub> - power density in mW/cm<sup>2</sup>

P - conducted output power to the antenna in mW

G - antenna gain (linear)

Sample calculation for DTS in 2.4 GHz band:

With a measured max. conducted output power of 523.6 mW and a max. antenna gain of 3.98 (6.0 dBi) the resulting power density at a distance of 20 cm will be

$$P_d = (523.6 \times 3.98) / (4 \times \pi \times 20^2) = 0.415 \text{ [mW/cm}^2\text{]}$$



### 4.3.3 Results

#### MPE Calculation

| Radio                                                       | Frequency Band [MHz]  | Maximum Output Power [mW] | Max. Antenna Gain | Calculated Power Density @ 20 cm distance [mW/cm <sup>2</sup> ] | Limit of Power Density [mW/cm <sup>2</sup> ] |
|-------------------------------------------------------------|-----------------------|---------------------------|-------------------|-----------------------------------------------------------------|----------------------------------------------|
| ISM                                                         | 913 ... 917           | 79.4                      | 1.00              | 0.0158                                                          | 0.61                                         |
| WLE200N2<br>WiFi Half Mini<br>PCIe<br>FCC ID<br>TK4WLE200N2 | 2412 ... 2462         | 523.6                     | 3.16              | 0.320                                                           | 1.0                                          |
| L850-GL<br>FCC ID:<br>ZMOL850GL                             | See list on<br>page 8 | 251.0                     | 2.51              | 0.125                                                           | 1.0                                          |

The calculated power density for simultaneous transmission of all three radio modules (ISM, WiFi and UMTS/LTE) at 20 cm distance is 0.461 mW/cm<sup>2</sup>. The worst case limit (ISM) is 0.61 mW/cm<sup>2</sup>.

### 4.3.4 Summary

Manufacturer: MYNXG Product GmbH  
Type: 110012  
Serial No.: 00001101  
Test date: 2019-08-01  
Test personnel: Patrick Reusch

**The EUT meets the requirements of this section.**

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## 5 TEST INSTRUMENTS

| EMCC ID # | Instrument                          | Manufacturer               | Model No.              | Last Calibration | Calibration valid until |
|-----------|-------------------------------------|----------------------------|------------------------|------------------|-------------------------|
| 1         | 60-Hz-Converter                     | AEG                        | DAMK4/DAGK4            | n/a              | n/a                     |
| 54        | N-Cable N/50                        | Rohde & Schwarz            | HFU2-Z5                | n/a              | n/a                     |
| 221       | N-Cable N/50                        | Berkenh. & Drebes          | RG 214                 | n/a              | n/a                     |
| 1012      | Lowpass Filter                      | Telonic                    | TLA 390-6CC1           | n/a              | n/a                     |
| 1037      | Octave Bandpass Filter              | Microphase                 | K0917                  | 2019-08          | 2021-08                 |
| 1043      | Highpass Filter                     | Microphase                 | HB 1000AB              | 2018-10          | 2020-10                 |
| 1048      | Lowpass Filter                      | Hewlett-Packard            | 360 B                  | 2018-01          | 2020-01                 |
| 1291      | Antenna Mast                        | Frankonia                  | FAM4                   | n/a              | n/a                     |
| 1292      | Multi Device Controller             | Frankonia                  | FC02                   | n/a              | n/a                     |
| 1807      | Tunable.Reject Filter               | Anthony                    | ATR 450-1000-3EE       | n/a              | n/a                     |
| 1808      | Tunable Reject Filter               | Anthony                    | ATR 1000-2000-3EE      | n/a              | n/a                     |
| 1889      | SR-ULL-01                           | EMCC/FRANK.                | SAC-10                 | n/a              | n/a                     |
| 2128      | N-Cable N/50                        | EMCC DR. RASEK             | RG 214                 | n/a              | n/a                     |
| 2400      | N-Cable N/50                        | EMCC DR. RASEK             | RG 214                 | n/a              | n/a                     |
| 2652      | N-Cable N/50                        | EMCC DR. RASEK             | RG 214                 | n/a              | n/a                     |
| 2666      | N-Cable N/50                        | EMCC DR. RASEK             | RG 214                 | n/a              | n/a                     |
| 2667      | N-Cable N/50                        | EMCC DR. RASEK             | RG 214                 | n/a              | n/a                     |
| 2724      | 5 W Attenuator 6dB                  | Weinschel                  | 2                      | 2019-07          | 2021-07                 |
| 2960      | Vector Network Analyzer             | Rohde & Schwarz            | ZVL 6                  | 2019-07          | 2021-07                 |
| 3065      | PC3.5-Cable PC7(N)/50               | EMCC DR. RASEK             | N-Sucoform141-PC35     | n/a              | n/a                     |
| 3203      | Logarithmic periodic ant.           | Schwarzbeck                | VUSLP 9111B            | 2019-01          | 2021-01                 |
| 3235      | Double Ridged Guide Antenna         | Schwarzbeck                | BBHA 9120D             | 2019-01          | 2021-01                 |
| 3236      | Double Ridged Guide Antenna         | Schwarzbeck                | BBHA 9120D             | 2019-01          | 2021-01                 |
| 3831      | Spectrum Analyzer                   | Rohde & Schwarz            | FSU50                  | 2018-10          | 2019-10                 |
| 3846      | EMI Test Receiver                   | Rohde & Schwarz            | ESU8                   | 2019-02          | 2020-02                 |
| 3880      | Digital Multimeter                  | Agilent                    | U1241B                 | 2018-07          | 2020-07                 |
| 4075      | Workstation                         | Dell                       | Optiplex 7010          | n/a              | n/a                     |
| 4717      | Web-Thermo-Hygrobarograph           | Wiesemann & Theis GmbH WUT | 57613 Web-T/Rh/P       | 2018-01          | 2020-01                 |
| 4993      | Band Reject Filter                  | ZYSEN                      | ZSBR2441.75-83.5U10CS  | 2018-02          | 2020-02                 |
| 5366      | High Pass Filter                    | dBd communications         | DBD-FTR-15SH-U3500-O/O | 2018-02          | 2020-02                 |
| 5392      | EMC Measurement Software (10.35.02) | Rohde & Schwarz            | EMC32                  | n/a              | n/a                     |
| 5535      | Positioning controller              | Rohde & Schwarz            | HCC                    | n/a              | n/a                     |
| 5536      | Rotary table                        | Rohde & Schwarz            | HCT12                  | n/a              | n/a                     |
| 5544      | Antenna Mast                        | innco systems GmbH         | MA 5000-XPET           | n/a              | n/a                     |
| 5545      | Antenna Mast Controller             | innco systems GmbH         | CO 3000-1D             | n/a              | n/a                     |
| 5616      | RF cable assembly                   | Rosenberger                | LA2-025-7000           | n/a              | n/a                     |
| 5620      | RF cable assembly                   | Rosenberger                | LA2-001-2000           | n/a              | n/a                     |
| 6041      | TRILOG Broadband Ant.               | Schwarzbeck                | VULB 9163              | 2017-09          | 2019-09                 |
| 6497      | N-Cable N/50                        | EMCC DR. RASEK             | RG214                  | n/a              | n/a                     |
| 6538      | N-Cable N/50                        | EMCC                       |                        | n/a              | n/a                     |

## 6 MEASUREMENT UNCERTAINTY

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| Measurement                       | Measurement Uncertainty |
|-----------------------------------|-------------------------|
| Radiated Emissions below 1000 MHz | $\pm 5.6$ dB            |
| Radiated Emissions above 1000 MHz | $\pm 4.6$ dB            |

The reported uncertainty values are based on a standard uncertainty multiplied by a coverage factor of  $k=2$ , providing a level of confidence of 95%.

The given values have been calculated on the basis of the following documents:

TR 100 028-1 V1.4.1 (2001-12), Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 1

TR 100 028-2 V1.4.1 (2001-12), Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 2

CISPR 16-4-2:2011+A1:2014, Specification for radio disturbance and immunity measuring apparatus and methods - Part 4-2: Uncertainties, statistics and limit modelling - Measurement instrumentation uncertainty.

JCGM 100:2008, Evaluation of measurement data - Guide to the expression of uncertainty in measurement.

## 7 LIST OF ANNEXES

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The following annexes are separated parts from this test report.

| Description                                           | Pages |
|-------------------------------------------------------|-------|
| Annex 1: Photographs of test setup                    | 3     |
| Annex 2: External photographs of equipment under test | 6     |
| Annex 3: Internal photographs of equipment under test | 9     |
| Annex 4: Photographs of ancillary equipment           | 3     |