# FCC Measurement/Technical Report on

# Multimedia Equipment with WLAN and Bluetooth

# BCI3L4PTN1(Star 3.0)

## FCC ID: 2AUXS-BCI3L4PTN1
## IC: 25847-BCI3L4PTN1

**Test Report Reference:** MDE_BOSCH_2511_FCC_02

**Test Laboratory:**
7layers GmbH
Borsigstrasse 11
40880 Ratingen
Germany

Deutsche Akkreditierungsstelle
D-PL-12140-01-00

Note:
The following test results relate only to the devices specified in this document. This report shall not be reproduced in parts without the written approval of the test laboratory.

Table of Contents


**1 Applied Standards and Test Summary 3**

1.1 Applied Standards 3

1.2 FCC-IC Correlation Table 4

1.3 Measurement Summary 5

**2 Revision History / Signatures 6**

**3 Administrative Data 7**

3.1 Testing Laboratory 7

3.2 Project Data 7

3.3 Applicant Data 7

3.4 Manufacturer Data 8

**4 Test object Data 9**

4.1 General EUT Description 9

4.2 EUT Main components 9

4.3 Ancillary Equipment 10

4.4 Auxiliary Equipment 10

4.5 EUT Setups 11

4.6 Operating Modes / Test Channels 11

4.7 Product labelling 11

**5 Test Results 12**

5.1 Radiated Emissions 12

**6 Test Equipment 21**

6.1 Test Equipment Hardware 21

6.2 Test Equipment Software 23

**7 Antenna Factors, Cable Loss and Sample Calculations 24**

7.1 Antenna R&S HL562 (30 MHz – 1 GHz) 24

7.2 Antenna R&S HF907 (1 GHz – 18 GHz) 25

7.3 Antenna EMCO 3160-09 (18 GHz – 26.5 GHz) 26

7.4 Antenna EMCO 3160-10 (26.5 GHz – 40 GHz) 27

**8 Measurement Uncertainties 28**

**9 Photo Report 29**

# 1 APPLIED STANDARDS AND TEST SUMMARY

## 1.1 APPLIED STANDARDS

**Applicable FCC Rules**

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Parts 2 and 15 (10-1-24 Edition). The following subparts are applicable to the results in this test report.

**Part 2, Subpart J - Equipment Authorization Procedures, Certification**

**Part 15, Subpart B – Unintentional Radiators**

§ 15.107 Conducted limits

§ 15.109 Radiated emission limits; general requirements

**Applicable ISED Standards**

ICES-Gen, Issue 1 + Amendment 1 (March 2019) + Amendment 2 (February 2021)

ICES-003, Issue 7

Note:
ANSI C63.4–2014 is applied.

## 1.2 FCC-IC CORRELATION TABLE

**Correlation of measurement requirements for Information Technology Equipment (ITE) from FCC and ISED Canada**

| Measurement | FCC reference | ISED reference |
|---|---|---|
| Conducted Emissions (AC Power Line) | §15.107 | ICES-003 Issue 7: 3.2.1 |
| Radiated Spurious Emissions | §15.109 | ICES-003 Issue 7: 3.2.2 |

**Remarks:**

1. FCC Part 15 subpart B, ICES 003 and CISPR 22 contain different definitions of Class A and Class B limits, i.e. which class is applicable to which kind of EUT.
   ICES 003 and CISPR 22 distinguish between the location where the EUT is intended to operate whilst FCC refers to the method of commercial distribution (distributive trades).
2. The correct assignment of the appropriate class to the concrete EUT is not scope of this test report!
3. A radio apparatus that is specifically subject to an ISED Radio Standard Specification (RSS) and which contains an ITE is not subject to ICES-003 provided the ITE is used only to enable operation of the radio apparatus and the ITE does not control additional functions or capabilities.
4. ISM (Industrial, Scientific or Medical) radio frequency generators, though they may contain ITE, are excluded from the definition of ITE and are not subject to ICES-003. They are instead subject to the Interference-Causing Equipment Standard ICES-001, which specifically addresses ISM radio frequency generators.

## 1.3 MEASUREMENT SUMMARY

| **47 CFR CHAPTER I FCC PART 15 Subpart B** | **§ 15.109 Class B** | | | |
|---|---|---|---|---|
| Radiated Emissions<br>The measurement was performed according to ANSI C63.4 | | | **Final Result** | |
| **OP-Mode**<br>AC mains connection, Measurement range, Test setup | **Setup** | **Date** | **FCC** | **IC** |
| via auxiliary equipment, 26 GHz - 40 GHz, stand-alone | S01_BB03#S3.0 | 2025-07-25 | Passed | Passed |
| via auxiliary equipment, 18 GHz - 26 GHz, stand-alone | S01_BB03#S3.0 | 2025-07-25 | Passed | Passed |
| via auxiliary equipment, 1 GHz - 18 GHz, stand-alone | S01_BB03#S3.0 | 2025-07-25 | Passed | Passed |
| via auxiliary equipment, 30 MHz - 1 GHz, stand-alone | S01_BB03#S3.0 | 2025-07-25 | Passed | Passed |

N/A: Not applicable
N/P: Not performed

## 2 REVISION HISTORY / SIGNATURES

| Report version control | | | |
|---|---|---|---|
| **Version** | **Release date** | **Change Description** | **Version validity** |
| initial | 2025-09-24 | -- | valid |
| -- | -- | -- | -- |

COMMENT:

According to the manufacturer's declaration, the device is not intended to be connected to the AC mains, and therefore the "conducted emissions" requirements for AC power lines do not apply.

(responsible for accreditation scope)
Dipl.-Ing. Robert Machulec

(responsible for testing and report)
BSc. Mhd Mouaz Saad

7 layers

7 layers GmbH, Borsigstr. 11
40880 Ratingen, Germany
Phone +49 (0)2102 749 0

# 3 ADMINISTRATIVE DATA

## 3.1 TESTING LABORATORY

| | |
|---|---|
| Company Name: | 7layers GmbH |
| Address: | Borsigstr. 11<br>40880 Ratingen<br>Germany |

The test facility is accredited by the following accreditation organisation:

| | |
|---|---|
| Laboratory accreditation no: | DAkkS D-PL-12140-01-00 |
| FCC Designation Number: | DE0015 |
| FCC Test Firm Registration: | 929146 |
| ISED CAB Identifier | DE0007; ISED#: 3699A |
| Responsible for accreditation scope: | Dipl.-Ing. Robert Machulec |
| Report Template Version: | 2025-02-28 |

## 3.2 PROJECT DATA

| | |
|---|---|
| Responsible for testing and report: | BSc. Mhd Mouaz Saad |
| Employees who performed the tests: | documented internally at 7Layers |
| Date of Report: | 2025-09-24 |
| Testing Period: | 2025-07-25 |

## 3.3 APPLICANT DATA

| | |
|---|---|
| Company Name: | Robert Bosch GmbH |
| Address: | Robert-Bosch-Platz 1, 70839 Gerlingen<br>Germany |
| Contact Person: | Karin Silberhorn |

## 3.4 MANUFACTURER DATA

**Manufacturer 1**

| | |
|---|---|
| Company Name: | Bosch Car Multimedia Portugal |
| Address: | S.A. Rua Max Grundig<br>35-Lomar,<br>4705-820 Braga |

**Manufacturer 2**

| | |
|---|---|
| Company Name: | Bosch Automotive Products (Suzhou) Co., Ltd. |
| Address: | Changzhou Branch<br>No. 17, Long Men Road,<br>Wujin Hi-tech Industrial Zone<br>Changzhou, Jiangsu, P.R. China |

# 4 TEST OBJECT DATA

## 4.1 GENERAL EUT DESCRIPTION

| | | |
|---|---|---|
| Kind of Device product description | Central In-Vehicle Infotainment Computer | |
| Product name | Multimedia Device with WLAN and Bluetooth | |
| Model name | BCI3L4PTN1(Star 3.0) | |
| **Declared EUT data by the supplier** | | |
| Power Supply Type | DC (via AUX01) | |
| Nominal Voltage / Frequency | 12 VDC (via AUX01) | |
| Test Voltage / Frequency | 12 VDC (via AUX01) | |
| Highest internal frequency | 5825 MHz | |
| General Description | Central In-Vehicle Infotainment Computer Gen20x.i3 infotainment system is the main unit in the vehicle, which combines the instrument cluster and infotainment functionality. It supports Bluetooth classic (BT), Bluetooth Low Energy(BTLE) and Wi-Fi (2.4GHz and 5GHz). | |
| Ports | Main Connector A(incl. DC Power) (unshielded, 1m) | GNSS antenna (shielded, 1.5m) |
| | Main Connector B (unshielded, 1m) | BT/WLAN Antenna (shielded, 1.5m) |
| | Ethernet (shielded, 1.5m) | HD-BaseT (shielded, 1.5m) |
| | FM/AM/SDARS/Ref.-Antennas | USB 2.0 – TGS (shielded, 1.5m) |
| | Video-Out Displays (shielded, 1.5m) | USB 2.0 - MM-Box (shielded, 1.5m) |
| | CamsControl(shielded, 1.5m) | Video-in Cameras (shielded, 1.5m) |
| | USB 3.0 High Speed Flashing/CAM Logging (shielded, 1.5m) | |
| Special software used for testing | ETGui.exe | |

## 4.2 EUT MAIN COMPONENTS

| **Sample Name** | **Sample Code** | **Description** |
|---|---|---|
| EUT A | DE1050026bb03 | Radiated Sample |
| **Sample Parameter** | **Value** | |
| Serial No. | 0028787 | |
| HW Version | D10 | |
| SW Version | E230.1 | |
| Comment | BCI3L4PTN1 - Star 3.0 | |

NOTE:The short description is used to simplify the identification of the EUT in this test report.

## 4.3 ANCILLARY EQUIPMENT

For the purposes of this test report, ancillary equipment is defined as equipment which is used in conjunction with the EUT to provide operational and control features to the EUT. It is necessary to configure the system in a typical fashion, as a customer would normally use it. But nevertheless Ancillary Equipment can influence the test results.

| **Device** | **Details(Manufacturer, Type Model, OUT Code)** | **Description** |
|---|---|---|
| ANC 1 | Continental, RKE223E1GNS, DE1050025/026AUX01 | GNSS Antenna + Antenna Cable (1.5m) |
| ANC 2 | Mercedes-Benz, A1779052902, DE1050025/026AUX45 | 4x WIFI/BT Antenna + 4x Antenna Cable (1.5m) |

## 4.4 AUXILIARY EQUIPMENT

For the purposes of this test report, auxiliary equipment is defined as equipment which is used temporarily to enable operational and control features especially used for the tests of the EUT which is not used during normal operation or equipment that is used during the tests in combination with the EUT but is not subject of this test report. It is necessary to configure the system in a typical fashion, as a customer would normally use it.
But nevertheless Auxiliary Equipment can influence the test results.

| **Device** | **Details (Manufacturer, Type Model, HW, SW, S/N)** | **Description** |
|---|---|---|
| AUX01 | Rohde&Schwarz, NGP800, - ,-, 101178 | Lab Power Supply |
| AUX02 | BOSCH, -, -, - | Main Harnes |
| AUX03 | Harman Becker, M782, 24/03.01, 24/08.01, M7829cR166900040 | MMA Amplifier |
| AUX04 | BOSCH, A1749051903, 23/30, -, E10 00550L24064 | Vehicle Passenger Camera |
| AUX05 | BOSCH, Cams-Cntrl termination box, -, -, - | Termination Box Cams |
| AUX06 | BOSCH, Diamler_CIVIC_I2, -, -, - | USB Box |
| AUX07 | Vector, VN5610A, - , -, 007167-017648 | Ethernet/CAN box |
| AUX08 | Vector, FW75550/12, -, -, 0092880 | AC/DC Adaptor for Vector Box |
| AUX09 | HP, HSN-C13C-5, -, Windows 11, CND2290G6L | Customer Laptop |
| AUX10 | Lit-on, TPN-CA11, -, -, 0A3UGMG1T | AC/DC Adaptor for Laptop |
| AUX11 | BOSCH, A2149003207, A2149012505, A2149026101, 0007202 | Display Cluster |

## 4.5 EUT SETUPS

This chapter describes the combination of EUTs and equipment used for testing. The rationale for selecting the EUTs, ancillary and auxiliary equipment and interconnecting cables, is to test a representative configuration meeting the requirements of the referenced standards.

| Setup | Combination of EUTs | Description and Rationale |
|---|---|---|
| S01_BB03#S3.0 | EUT A, ANC 1, ANC 2, AUX01 to AUX11 | Radiated Setup |

## 4.6 OPERATING MODES / TEST CHANNELS

This chapter describes the operating modes of the EUTs used for testing.

- TX Standby with Vehicle Ethernet Traffic

## 4.7 PRODUCT LABELLING

### 4.7.1 FCC ID LABEL

Please refer to the documentation of the applicant.

### 4.7.2 LOCATION OF THE LABEL ON THE EUT

Please refer to the documentation of the applicant.

# 5 TEST RESULTS

## 5.1 RADIATED EMISSIONS

Standard **FCC Part 15 Subpart B**

**The test was performed according to:**
ANSI C63.4

### 5.1.1 TEST DESCRIPTION

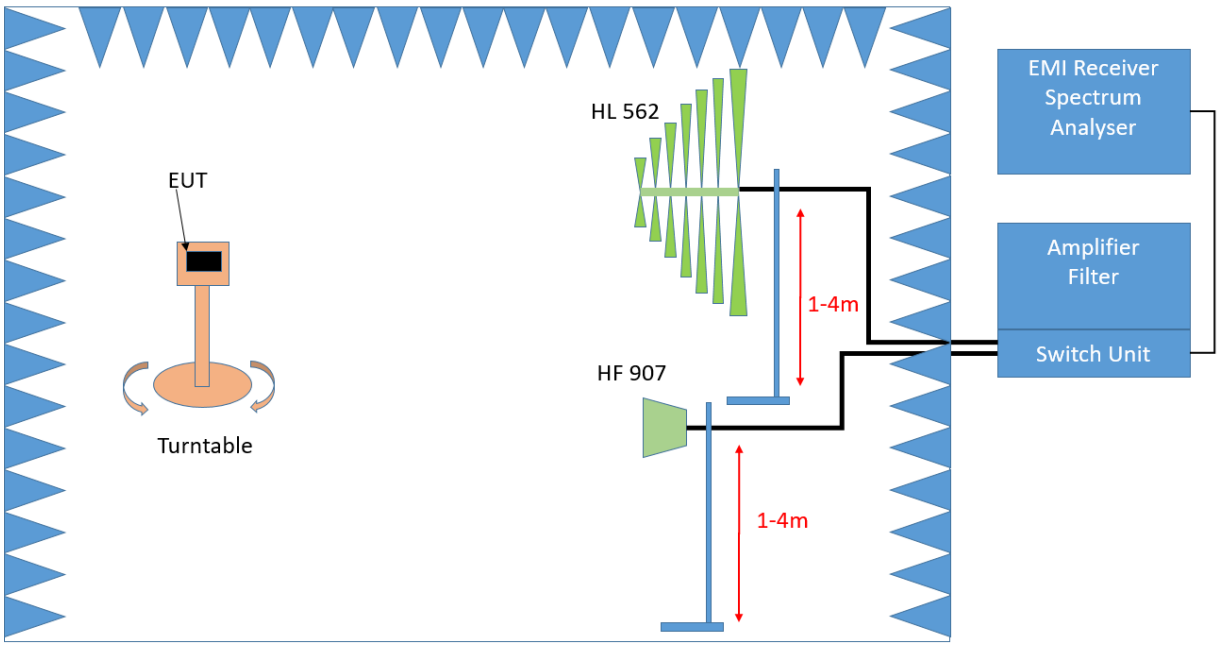
The test set-up was made in accordance to the general provisions of ANSI C63.4 in a typical installation configuration. The measurements were performed according to the following sub-chapters of ANSI C63.4:

- 30 MHz – 1 GHz: Chapter 8.3.2.1
- > 1 GHz: Chapter 8.3.2.2

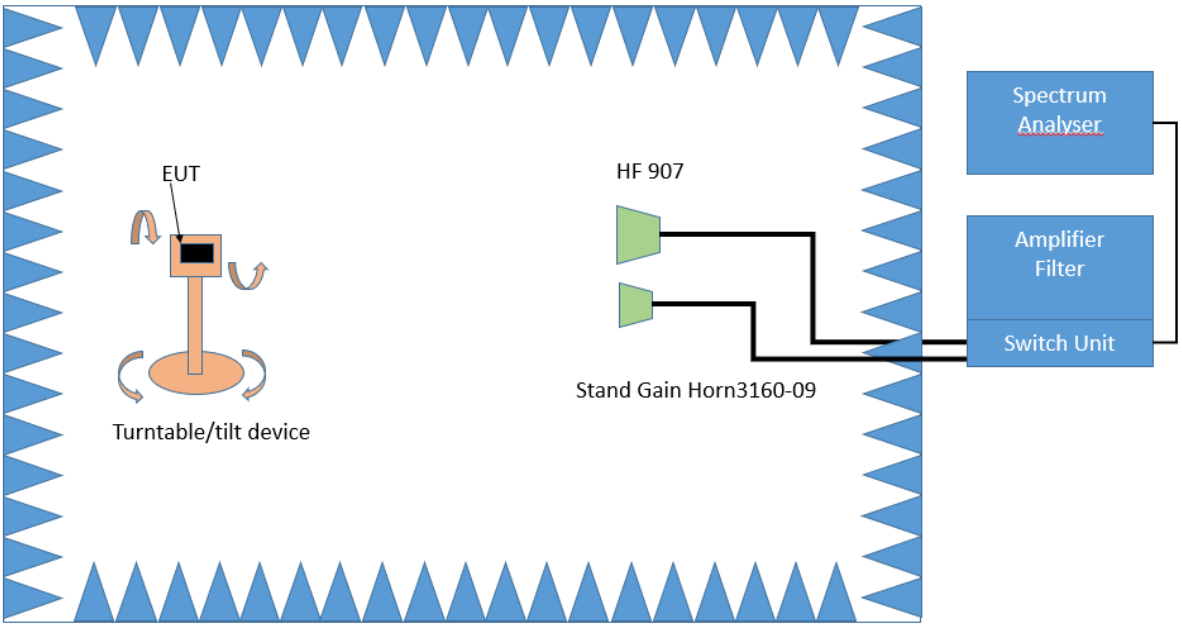
The measurement procedure is implemented into the EMI test software EMC32 from R&S. Exploratory tests are performed at 3 orthogonal axes to determine the worst-case orientation of a body-worn or handheld EUT. The final test on all kind of EUTs is also performed at 3 axes. A pre-check is performed while the EUT is powered.

The Equipment Under Test (EUT) was set up on a non-conductive table in the semi-anechoic chamber. The influence of the EUT support table that is used between 30–1000 MHz was evaluated.

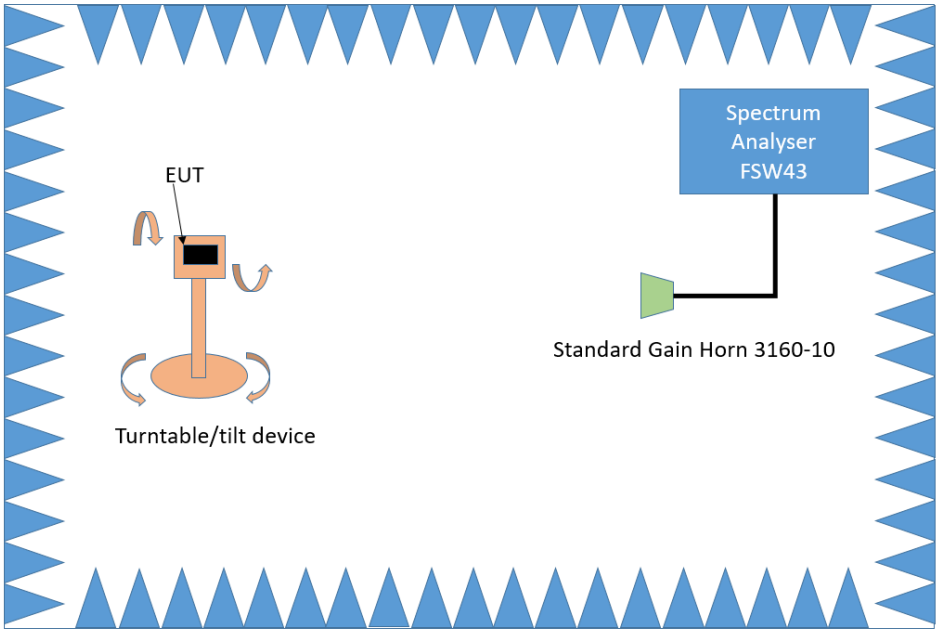
**1. Measurement setup**




Test Setup; Spurious Emission Radiated (SAC)




Test Setup; Spurious Emission Radiated (FAC), 1 GHz-26.5 GHz




Test Setup; Spurious Emission Radiated (FAC), 26.5 – 40 GHz

**Frequency range 30 MHz – 1 GHz**

**Step 1:** Preliminary scan
This is a preliminary test to identify the highest amplitudes relative to the limit.
Settings for step 1:
- Antenna distance: 3 m
- Detector: Peak-Max-hold / Quasi-Peak (FFT-based)
- Frequency range: 30 – 1000 MHz
- Frequency steps: 30 kHz
- IF–Bandwidth: 120 kHz
- Measuring time / Frequency step: 100 ms
- Turntable angle range: –180° to 90°
- Turntable step size: 90°
- Height variation range: 1 – 4 m
- Height variation step size: 1.5 m
- Polarisation: Horizontal + Vertical

Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

**Step 2:** Adjustment measurement
In this step the accuracy of the turntable azimuth and antenna height will be improved. This is necessary to find out the maximum value of every frequency.
For each frequency, which was determined the turntable azimuth and antenna height will be adjusted. The turntable azimuth will slowly vary by 360°. During this action, the value of emission is continuously measured. The turntable azimuth at the highest emission will be recorded and adjusted. In this position, the antenna height will slowly vary between 1 – 4 m. During this action, the value of emission is also continuously measured. The antenna height of the highest emission will also be recorded and adjusted.
- Detector: Peak – Max-hold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100 ms
- Turntable angle range: 360 °
- Height variation range:1 – 4 m
- Antenna Polarization: max. value determined in step 1

**Step 3:** Final measurement with QP detector
With the settings determined in step 2, the final measurement will be performed:
EMI receiver settings for step 3:
- Detector: Quasi-Peak
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 1 s

**Above 1 GHz:**

The following changes apply to the measurement procedure for the frequency range above 1 GHz:

**Step 1:**
- Turntable step size: 45°
- Detector: Peak, Average (Max-hold)
- IF – Bandwidth: 1 MHz
- Frequency steps: 250 kHz
- Measuring time: 500 ms / GHz

**Step 2:**
- IF – Bandwidth: 1 MHz

**Step 3:**
- Detector: Peak / CISPR Average
- IF – Bandwidth: 1 MHz

After every measurement a plot will be generated which contains a diagram with the results of the preliminary scan and a chart with the frequencies and values of the results of the final measurement.

### 5.1.2 TEST REQUIREMENTS / LIMITS

FCC Part 15, Subpart B, §15.109, Radiated Emission Limits

**Class B:**

| Frequency (MHz) | Limit (µV/m) | Measurement distance (m) | Limits (dBµV/m) |
|---|---|---|---|
| 30 – 88 | 100@3m | 3 | 40.0@3m |
| 88 – 216 | 150@3m | 3 | 43.5@3m |
| 216 – 960 | 200@3m | 3 | 46.0@3m |
| 960 - 26000 | 500@3m | 3 | 54.0@3m |
| 26000 - 40000 | 500@3m | 1 | 54.0@3m |

**Class A:**

| Frequency (MHz) | Limit (µV/m) | Measurement distance (m) | Limits (dBµV/m) |
|---|---|---|---|
| 30 – 88 | 90@10m | 3 | 39.1@10m |
| 88 – 216 | 150@10m | 3 | 43.5@10m |
| 216 – 960 | 210@10m | 3 | 46.4@10m |
| 960 - 26000 | 300@10m | 3 | 49.5@10m |
| 26000 - 40000 | 300@10m | 1 | 49.5@10m |

The measured values for Class A and for Class B (> 26 GHz) measurements are corrected with an inverse linear distance extrapolation factor (20 dB/decade).

§15.35(b) ..., there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit....

Used conversion factor: Limit (dBµV/m) = 20 log (Limit (µV/m)/1µV/m)

### 5.1.3 TEST PROTOCOL

Ambient temperature: 23 °C
Air Pressure: 1009 hPa
Humidity: 36 %
via auxiliary equipment, stand-alone

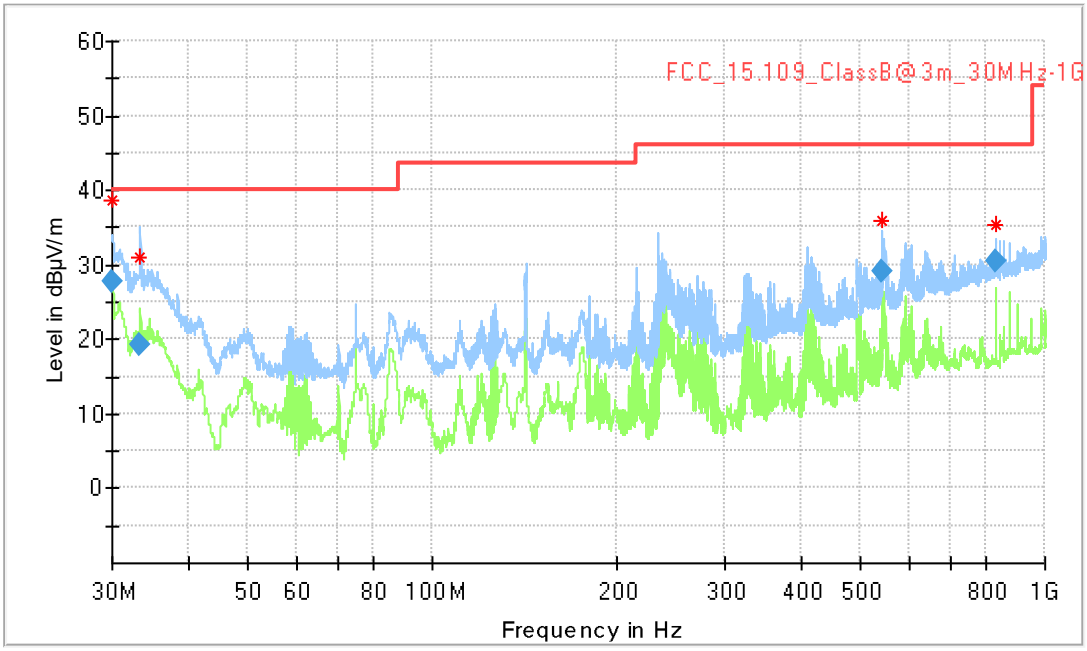
| Spurious Freq. [MHz] | Spurious Level [dBµV/m] | Detector | RBW [kHz] | Limit [dBµV/m] | Margin to Limit [dB] |
|---|---|---|---|---|---|
| 30.0 | 27.7 | QP | 120 | 40.0 | 12.3 |
| 33.3 | 19.3 | QP | 120 | 40.0 | 20.7 |
| 543.1 | 29.0 | QP | 120 | 46.0 | 17.0 |
| 829.2 | 30.5 | QP | 120 | 46.0 | 15.5 |

Remark: Please see next sub-clause for the measurement plot.

## 5.1.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)

**Common Information**

| | |
|---|---|
| Test Description: | Radiated Emissions, Test Site: Semi Anechoic Chamber @ 3 m |
| Test Standard: | FCC §15.109, ANSI C63.4 |
| EUT / Setup Code: | DE1050026bb03 / S01_BB03#S3.0 |
| Operating Conditions: | AC:120 V 60 Hz, DC via AUX01: 12 V |
| Comment: | TX Standby with Vehicle Ethernet Traffic |
| Legend: | Trace (preview): blue = PK, green = QP; Star: red or blue = critical frequency; Rhombus: blue = final QP |

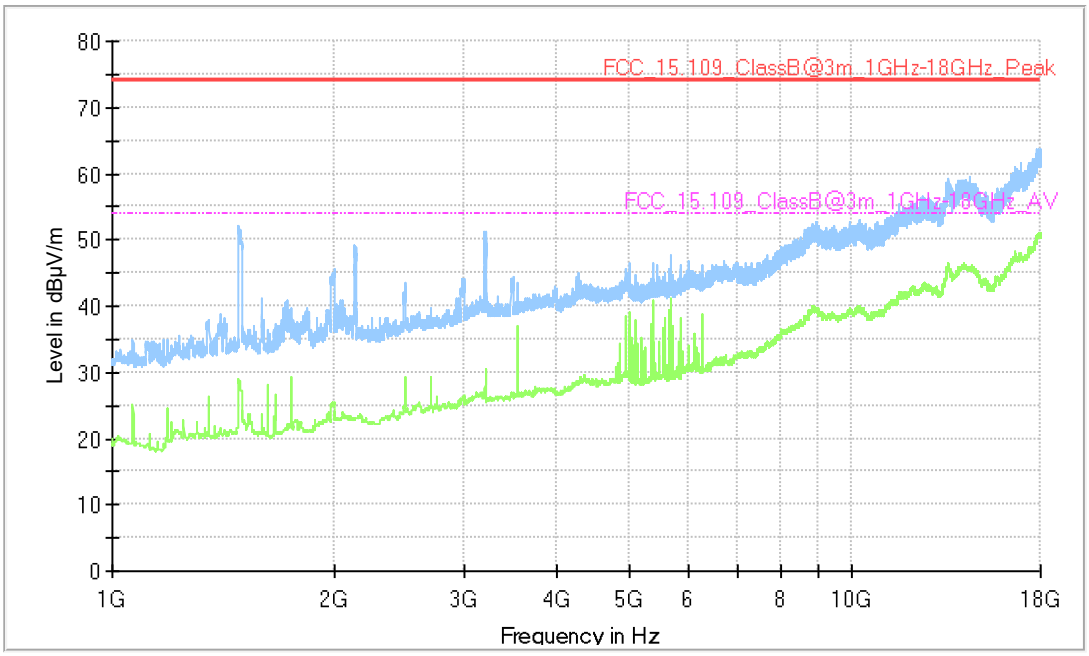



**Final_Result**

| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) |
|---|---|---|---|---|---|---|---|---|---|
| 30.030000 | 27.7 | 40.00 | 12.3 | 1000.0 | 120.000 | 106.0 | V | 70 | 19.5 |
| 33.330000 | 19.3 | 40.00 | 20.7 | 1000.0 | 120.000 | 118.0 | V | 38 | 17.6 |
| 543.120000 | 29.0 | 46.00 | 17.0 | 1000.0 | 120.000 | 100.0 | H | 348 | 19.9 |
| 829.200000 | 30.5 | 46.00 | 15.5 | 1000.0 | 120.000 | 145.0 | V | 183 | 24.5 |

## Common Information

| | |
|---|---|
| Test Description: | Radiated Emissions @ 3 m, SAC + mobile floor absorber |
| Test Standard: | FCC 15.109 Class B |
| EUT / Setup Code: | DE1050026bb03 / S01_BB03#S3.0 |
| Operating Conditions: | AC:120 V 60 Hz, DC via AUX01: 12 V |
| Comment: | TX Standby with Vehicle Ethernet Traffic |
| Legend: | Trace (preview): blue = PK, green = AV; Star: red or blue = critical frequency; Rhombus: blue = final Peak, green = Final CISPR AV |

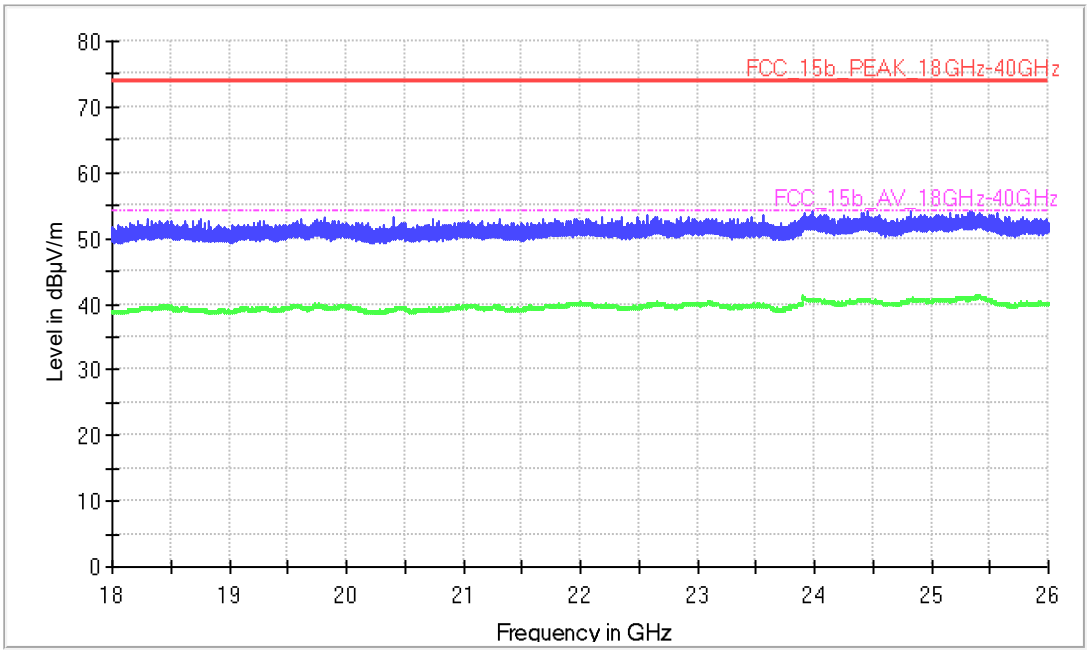



## Final_Result

| Frequency (MHz) | MaxPeak (dBµV/m) | CAverage (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) |
|---|---|---|---|---|---|---|---|---|---|---|
| --- | --- | --- | --- | --- | --- | --- | --- | | --- | --- |

## Common Information

| | |
|---|---|
| Test Description: | Radiated Emissions @ 1 m, SAC + mobile floor absorber |
| Test Standard: | FCC 15.109 Class B |
| EUT / Setup Code: | DE1050026bb03 / S01_BB03#S3.0 |
| Operating Conditions: | AC:120 V 60 Hz, DC via AUX01: 12 V |
| Comment: | TX Standby with Vehicle Ethernet Traffic |
| Legend: | Trace (preview): blue = PK, green = AV; Star: red or blue = critical frequency; Rhombus: blue = final Peak, green = Final CISPR AV |
| Distance corr. 3 m / 1 m: | 9.5 dB subtracted from measurement value(s) |

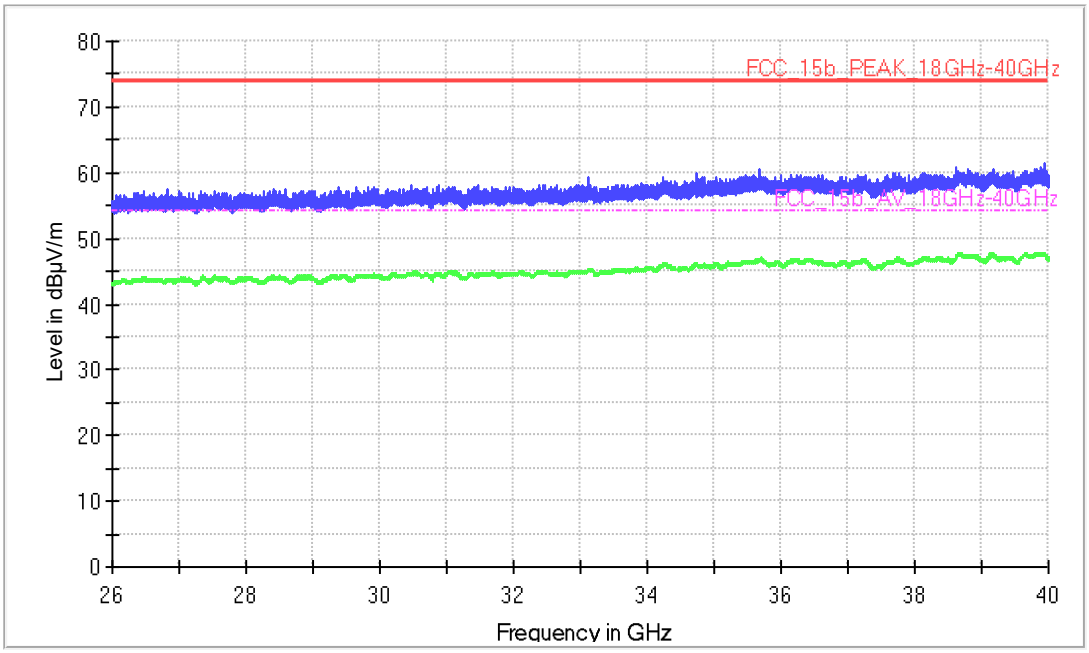



## Final_Result

| Frequency (MHz) | MaxPeak (dBµV/m) | CAverage (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) | Comment |
|---|---|---|---|---|---|---|---|---|---|---|---|
| --- | --- | --- | --- | --- | --- | --- | --- | | --- | --- | |

**Common Information**

| | |
|---|---|
| Test Description: | Radiated Emissions @ 1 m, SAC + mobile floor absorber |
| Test Standard: | FCC 15.109 Class B |
| EUT / Setup Code: | DE1050026bb03 / S01_BB03#S3.0 |
| Operating Conditions: | AC:120 V 60 Hz, DC via AUX01: 12 V |
| Comment: | TX Standby with Vehicle Ethernet Traffic |
| Legend: | Trace (preview): blue = PK, green = AV; Star: red or blue = critical frequency; Rhombus: blue = final Peak, green = Final CISPR AV |
| Distance corr. 3 m / 1 m: | 9.5 dB subtracted from measurement value(s) |




**Final_Result**

| Frequency (MHz) | MaxPeak (dBµV/m) | CAverage (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) | Comment |
|---|---|---|---|---|---|---|---|---|---|---|---|
| --- | --- | --- | --- | --- | --- | --- | --- | | --- | --- | |

## 5.1.5 TEST EQUIPMENT USED

- Radiated Emissions SAC above 1 GHz
- Radiated Emissions SAC up to 1 GHz

# 6 TEST EQUIPMENT

## 6.1 TEST EQUIPMENT HARDWARE

1 Radiated Emissions SAC above 1 GHz
Radiated emission tests above 1 GHz in a semi anechoic room with floor absorbers

| Ref.No. | Device Name | Description | Manufacturer | Serial Number | Last Calibration | Calibration Due |
|---|---|---|---|---|---|---|
| 1.1 | N5000/NP | Filter for EUT, 2 Lines, 250 V, 16 A | ETS-LINDGREN | 241515 | N/A | N/A |
| 1.2 | Opus10 TPR (8253.00) | T/P Logger 13 | Lufft Mess- und Regeltechnik GmbH | 13936 | 2023-12 | 2025-12 |
| 1.3 | ESW44 | EMI Receiver / Spectrum Analyzer | Rohde & Schwarz GmbH & Co. KG | 101603 | 2024-03 | 2026-03 |
| 1.4 | Anechoic Chamber 01 | SAC/FAR, 10.58 m x 6.38 m x 6.00 m | Frankonia Germany EMC Solution GmbH | none | N/A | N/A |
| 1.5 | 3160-09 | Standard Gain / Pyramidal Horn Antenna 26.5 GHz | EMCO Elektronic GmbH | 00083069 | N/A | N/A |
| 1.6 | Fluke 177 | Digital Multimeter 03 (Multimeter) | Fluke Europe B.V. | 86670383 | 2023-08 | 2025-08 |
| 1.7 | Opus10 THI (8152.00) | T/H Logger 10 | Lufft Mess- und Regeltechnik GmbH | 12488 | 2023-12 | 2025-12 |
| 1.8 | EP 1200/B, NA/B1 | AC Source, Amplifier with integrated variable Oscillator | Spitzenberger & Spies GmbH & Co. KG | B6278 | N/A | N/A |
| 1.9 | 3160-10 | Standard Gain / Pyramidal Horn Antenna 40 GHz | EMCO Elektronic GmbH | 00086675 | N/A | N/A |
| 1.10 | DS 420S | Turn Table 2 m diameter | HD GmbH | 420/573/99 | N/A | N/A |
| 1.11 | JS4-00102600-42-5A | Broadband Amplifier 30 MHz - 26 GHz | Miteq | 619368 | N/A | N/A |
| 1.12 | MA4985-XP-ET | Bore Sight Antenna Mast | innco systems GmbH | none | N/A | N/A |
| 1.13 | BB4312-C30-H3x | Filter Universal 1A | Siemens Matsushita Components | none | N/A | N/A |
| 1.14 | CS-RUB6 | Rubidium Frequency Standard | Rohde & Schwarz GmbH & Co. KG | 100321 | 2023-10 | 2025-10 |
| 1.15 | HF 907-2 | Double-ridged horn | Rohde & Schwarz | 102817 | 2022-07 | 2025-07 |

2 Radiated Emissions SAC up to 1 GHz
Radiated emission tests up to 1 GHz in a semi anechoic room

| Ref.No. | Device Name | Description | Manufacturer | Serial Number | Last Calibration | Calibration Due |
|---|---|---|---|---|---|---|
| 2.1 | N5000/NP | Filter for EUT, 2 Lines, 250 V, 16 A | ETS-LINDGREN | 241515 | N/A | N/A |
| 2.2 | Opus10 TPR (8253.00) | T/P Logger 13 | Lufft Mess- und Regeltechnik GmbH | 13936 | 2023-12 | 2025-12 |
| 2.3 | ESW44 | EMI Receiver / Spectrum Analyzer | Rohde & Schwarz GmbH & Co. KG | 101603 | 2024-03 | 2026-03 |
| 2.4 | Anechoic Chamber 01 | SAC/FAR, 10.58 m x 6.38 m x 6.00 m | Frankonia Germany EMC Solution GmbH | none | N/A | N/A |
| 2.5 | Fluke 177 | Digital Multimeter 03 (Multimeter) | Fluke Europe B.V. | 86670383 | 2023-08 | 2025-08 |
| 2.6 | Opus10 THI (8152.00) | T/H Logger 10 | Lufft Mess- und Regeltechnik GmbH | 12488 | 2023-12 | 2025-12 |
| 2.7 | EP 1200/B, NA/B1 | AC Source, Amplifier with integrated variable Oscillator | Spitzenberger & Spies GmbH & Co. KG | B6278 | N/A | N/A |
| 2.8 | DS 420S | Turn Table 2 m diameter | HD GmbH | 420/573/99 | N/A | N/A |
| 2.9 | HL562E ULTRALOG | Biconical-log-per Antenna (30 MHz - 6 GHz) | Rohde & Schwarz GmbH & Co. KG | 102299 | 2024-07 | 2027-07 |
| 2.10 | CS-RUB6 | Rubidium Frequency Standard | Rohde & Schwarz GmbH & Co. KG | 100321 | 2023-10 | 2025-10 |
| 2.11 | AM 4.0 | Antenna Mast 4 m | Maturo GmbH | AM4.0/180/1192 0513 | N/A | N/A |

The calibration interval is the time interval between “Last Calibration” and “Calibration Due”

## 6.2 TEST EQUIPMENT SOFTWARE

| **Semi-Anechoic Chamber:** | |
|---|---|
| Software | Version |
| EMC32 Measurement Software | 10.60.10 |
| INNCO Mast Controller | 1.02.62 |
| INNCO Mast Height | 34.10 |
| INNCO Mast Elevation | 36.11 |
| MATURO Controller | 1.24 |
| MATURO Mast | 12.19 |
| MATURO Turn-Table | 30.10 |
| **Fully-Anechoic Chamber:** | |
| Software | Version |
| EMC32 Measurement Software | 10.60.10 |
| MATURO Controller | 1.30 |
| MATURO Turn-Unit | 11.10 |
| MATURO Mast | 12.10 |
| MATURO Turntable | 12.11 |
| INNCO Controller | 1.03.02 |
| INNCO Mast Height | 34.10 |
| INNCO Mast Elevation | 36.11 |
| **TS 8997** | |
| WMS32 Measurement Software | 11.60.00 (till 2024-03-19), 11.70.00 + Hotfix 01 |
| **Conducted AC Emissions:** | |
| Software | Version |
| EMC32 Measurement Software | 10.60.20 |

# 7 ANTENNA FACTORS, CABLE LOSS AND SAMPLE CALCULATIONS

This chapter contains the antenna factors with their corresponding path loss of the used measurement path for all antennas as well as the insertion loss of the LISN.

## 7.1 ANTENNA R&S HL562 (30 MHZ – 1 GHZ)

**($d_{Limit}$ = 3 m)**

| Frequency | AF R&S HL562 | Corr. | cable loss 1 (inside chamber) | cable loss 2 (outside chamber) | cable loss 3 (switch unit) | cable loss 4 (to receiver) | distance corr. (-20 dB/ decade) | $d_{Limit}$ (meas. distance (limit) | $d_{used}$ (meas. distance (used) |
|---|---|---|---|---|---|---|---|---|---|
| MHz | dB (1/m) | dB | dB | dB | dB | dB | dB | m | m |
| 30 | 18.6 | 0.6 | 0.29 | 0.04 | 0.23 | 0.02 | 0.0 | 3 | 3 |
| 50 | 6.0 | 0.9 | 0.39 | 0.09 | 0.32 | 0.08 | 0.0 | 3 | 3 |
| 100 | 9.7 | 1.2 | 0.56 | 0.14 | 0.47 | 0.08 | 0.0 | 3 | 3 |
| 150 | 7.9 | 1.6 | 0.73 | 0.20 | 0.59 | 0.12 | 0.0 | 3 | 3 |
| 200 | 7.6 | 1.9 | 0.84 | 0.21 | 0.70 | 0.11 | 0.0 | 3 | 3 |
| 250 | 9.5 | 2.1 | 0.98 | 0.24 | 0.80 | 0.13 | 0.0 | 3 | 3 |
| 300 | 11.0 | 2.3 | 1.04 | 0.26 | 0.89 | 0.15 | 0.0 | 3 | 3 |
| 350 | 12.4 | 2.6 | 1.18 | 0.31 | 0.96 | 0.13 | 0.0 | 3 | 3 |
| 400 | 13.6 | 2.9 | 1.28 | 0.35 | 1.03 | 0.19 | 0.0 | 3 | 3 |
| 450 | 14.7 | 3.1 | 1.39 | 0.38 | 1.11 | 0.22 | 0.0 | 3 | 3 |
| 500 | 15.6 | 3.2 | 1.44 | 0.39 | 1.20 | 0.19 | 0.0 | 3 | 3 |
| 550 | 16.3 | 3.5 | 1.55 | 0.46 | 1.24 | 0.23 | 0.0 | 3 | 3 |
| 600 | 17.2 | 3.5 | 1.59 | 0.43 | 1.29 | 0.23 | 0.0 | 3 | 3 |
| 650 | 18.1 | 3.6 | 1.67 | 0.34 | 1.35 | 0.22 | 0.0 | 3 | 3 |
| 700 | 18.5 | 3.6 | 1.67 | 0.42 | 1.41 | 0.15 | 0.0 | 3 | 3 |
| 750 | 19.1 | 4.1 | 1.87 | 0.54 | 1.46 | 0.25 | 0.0 | 3 | 3 |
| 800 | 19.6 | 4.1 | 1.90 | 0.46 | 1.51 | 0.25 | 0.0 | 3 | 3 |
| 850 | 20.1 | 4.4 | 1.99 | 0.60 | 1.56 | 0.27 | 0.0 | 3 | 3 |
| 900 | 20.8 | 4.7 | 2.14 | 0.60 | 1.63 | 0.29 | 0.0 | 3 | 3 |
| 950 | 21.1 | 4.8 | 2.22 | 0.60 | 1.66 | 0.33 | 0.0 | 3 | 3 |
| 1000 | 21.6 | 4.9 | 2.23 | 0.61 | 1.71 | 0.30 | 0.0 | 3 | 3 |

**($d_{Limit}$ = 10 m)**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 30 | 18.6 | -9.9 | 0.29 | 0.04 | 0.23 | 0.02 | -10.5 | 10 | 3 |
| 50 | 6.0 | -9.6 | 0.39 | 0.09 | 0.32 | 0.08 | -10.5 | 10 | 3 |
| 100 | 9.7 | -9.2 | 0.56 | 0.14 | 0.47 | 0.08 | -10.5 | 10 | 3 |
| 150 | 7.9 | -8.8 | 0.73 | 0.20 | 0.59 | 0.12 | -10.5 | 10 | 3 |
| 200 | 7.6 | -8.6 | 0.84 | 0.21 | 0.70 | 0.11 | -10.5 | 10 | 3 |
| 250 | 9.5 | -8.3 | 0.98 | 0.24 | 0.80 | 0.13 | -10.5 | 10 | 3 |
| 300 | 11.0 | -8.1 | 1.04 | 0.26 | 0.89 | 0.15 | -10.5 | 10 | 3 |
| 350 | 12.4 | -7.9 | 1.18 | 0.31 | 0.96 | 0.13 | -10.5 | 10 | 3 |
| 400 | 13.6 | -7.6 | 1.28 | 0.35 | 1.03 | 0.19 | -10.5 | 10 | 3 |
| 450 | 14.7 | -7.4 | 1.39 | 0.38 | 1.11 | 0.22 | -10.5 | 10 | 3 |
| 500 | 15.6 | -7.2 | 1.44 | 0.39 | 1.20 | 0.19 | -10.5 | 10 | 3 |
| 550 | 16.3 | -7.0 | 1.55 | 0.46 | 1.24 | 0.23 | -10.5 | 10 | 3 |
| 600 | 17.2 | -6.9 | 1.59 | 0.43 | 1.29 | 0.23 | -10.5 | 10 | 3 |
| 650 | 18.1 | -6.9 | 1.67 | 0.34 | 1.35 | 0.22 | -10.5 | 10 | 3 |
| 700 | 18.5 | -6.8 | 1.67 | 0.42 | 1.41 | 0.15 | -10.5 | 10 | 3 |
| 750 | 19.1 | -6.3 | 1.87 | 0.54 | 1.46 | 0.25 | -10.5 | 10 | 3 |
| 800 | 19.6 | -6.3 | 1.90 | 0.46 | 1.51 | 0.25 | -10.5 | 10 | 3 |
| 850 | 20.1 | -6.0 | 1.99 | 0.60 | 1.56 | 0.27 | -10.5 | 10 | 3 |
| 900 | 20.8 | -5.8 | 2.14 | 0.60 | 1.63 | 0.29 | -10.5 | 10 | 3 |
| 950 | 21.1 | -5.6 | 2.22 | 0.60 | 1.66 | 0.33 | -10.5 | 10 | 3 |
| 1000 | 21.6 | -5.6 | 2.23 | 0.61 | 1.71 | 0.30 | -10.5 | 10 | 3 |

**Sample calculation**

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
distance correction = -20 * LOG ($d_{Limit}$/ $d_{used}$)
Linear interpolation will be used for frequencies in between the values in the table.
Tables show an extract of values.

## 7.2 ANTENNA R&S HF907 (1 GHZ – 18 GHZ)

| Frequency | AF R&S HF907 | Corr. | cable loss 1 (relay + cable inside chamber) | cable loss 2 (outside chamber) | cable loss 3 (switch unit, atten-uator & pre-amp) | cable loss 4 (to receiver) | | |
|---|---|---|---|---|---|---|---|---|
| MHz | dB (1/m) | dB | dB | dB | dB | dB | | |
| 1000 | 24.4 | -19.4 | 0.99 | 0.31 | -21.51 | 0.79 | | |
| 2000 | 28.5 | -17.4 | 1.44 | 0.44 | -20.63 | 1.38 | | |
| 3000 | 31.0 | -16.1 | 1.87 | 0.53 | -19.85 | 1.33 | | |
| 4000 | 33.1 | -14.7 | 2.41 | 0.67 | -19.13 | 1.31 | | |
| 5000 | 34.4 | -13.7 | 2.78 | 0.86 | -18.71 | 1.40 | | |
| 6000 | 34.7 | -12.7 | 2.74 | 0.90 | -17.83 | 1.47 | | |
| 7000 | 35.6 | -11.0 | 2.82 | 0.86 | -16.19 | 1.46 | | |

| Frequency | AF R&S HF907 | Corr. | cable loss 1 (relay inside chamber) | cable loss 2 (inside chamber) | cable loss 3 (outside chamber) | cable loss 4 (switch unit, atten-uator & pre-amp) | cable loss 5 (to receiver) | used for FCC 15.247 |
|---|---|---|---|---|---|---|---|---|
| MHz | dB (1/m) | dB | dB | dB | dB | dB | dB | |
| 3000 | 31.0 | -23.4 | 0.47 | 1.87 | 0.53 | -27.58 | 1.33 | |
| 4000 | 33.1 | -23.3 | 0.56 | 2.41 | 0.67 | -28.23 | 1.31 | |
| 5000 | 34.4 | -21.7 | 0.61 | 2.78 | 0.86 | -27.35 | 1.40 | |
| 6000 | 34.7 | -21.2 | 0.58 | 2.74 | 0.90 | -26.89 | 1.47 | |
| 7000 | 35.6 | -19.8 | 0.66 | 2.82 | 0.86 | -25.58 | 1.46 | |

| Frequency | AF R&S HF907 | Corr. | cable loss 1 (relay inside chamber) | cable loss 2 (High Pass) | cable loss 3 (pre-amp) | cable loss 4 (inside chamber) | cable loss 5 (outside chamber) | cable loss 6 (to receiver) |
|---|---|---|---|---|---|---|---|---|
| MHz | dB (1/m) | dB | dB | dB | dB | dB | dB | dB |
| 7000 | 35.6 | -57.3 | 0.56 | 1.28 | -62.72 | 2.66 | 0.94 | 1.46 |
| 8000 | 36.3 | -56.3 | 0.69 | 0.71 | -61.49 | 2.84 | 1.00 | 1.53 |
| 9000 | 37.1 | -55.3 | 0.68 | 0.65 | -60.80 | 3.06 | 1.09 | 1.60 |
| 10000 | 37.5 | -56.2 | 0.70 | 0.54 | -61.91 | 3.28 | 1.20 | 1.67 |
| 11000 | 37.5 | -55.3 | 0.80 | 0.61 | -61.40 | 3.43 | 1.27 | 1.70 |
| 12000 | 37.6 | -53.7 | 0.84 | 0.42 | -59.70 | 3.53 | 1.26 | 1.73 |
| 13000 | 38.2 | -53.5 | 0.83 | 0.44 | -59.81 | 3.75 | 1.32 | 1.83 |
| 14000 | 39.9 | -56.3 | 0.91 | 0.53 | -63.03 | 3.91 | 1.40 | 1.77 |
| 15000 | 40.9 | -54.1 | 0.98 | 0.54 | -61.05 | 4.02 | 1.44 | 1.83 |
| 16000 | 41.3 | -54.1 | 1.23 | 0.49 | -61.51 | 4.17 | 1.51 | 1.85 |
| 17000 | 42.8 | -54.4 | 1.36 | 0.76 | -62.36 | 4.34 | 1.53 | 2.00 |
| 18000 | 44.2 | -54.7 | 1.70 | 0.53 | -62.88 | 4.41 | 1.55 | 1.91 |

**Sample calculation**

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table.
Tables show an extract of values.

## 7.3 ANTENNA EMCO 3160-09 (18 GHZ – 26.5 GHZ)

| Frequency | AF EMCO 3160-09 | Corr. | cable loss 1 (inside chamber) | cable loss 2 (pre-amp) | cable loss 3 (inside chamber) | cable loss 4 (switch unit) | cable loss 5 (to receiver) |
|---|---|---|---|---|---|---|---|
| MHz | dB (1/m) | dB | dB | dB | dB | dB | dB |
| 18000 | 40.2 | -23.5 | 0.72 | -35.85 | 6.20 | 2.81 | 2.65 |
| 18500 | 40.2 | -23.2 | 0.69 | -35.71 | 6.46 | 2.76 | 2.59 |
| 19000 | 40.2 | -22.0 | 0.76 | -35.44 | 6.69 | 3.15 | 2.79 |
| 19500 | 40.3 | -21.3 | 0.74 | -35.07 | 7.04 | 3.11 | 2.91 |
| 20000 | 40.3 | -20.3 | 0.72 | -34.49 | 7.30 | 3.07 | 3.05 |
| 20500 | 40.3 | -19.9 | 0.78 | -34.46 | 7.48 | 3.12 | 3.15 |
| 21000 | 40.3 | -19.1 | 0.87 | -34.07 | 7.61 | 3.20 | 3.33 |
| 21500 | 40.3 | -19.1 | 0.90 | -33.96 | 7.47 | 3.28 | 3.19 |
| 22000 | 40.3 | -18.7 | 0.89 | -33.57 | 7.34 | 3.35 | 3.28 |
| 22500 | 40.4 | -19.0 | 0.87 | -33.66 | 7.06 | 3.75 | 2.94 |
| 23000 | 40.4 | -19.5 | 0.88 | -33.75 | 6.92 | 3.77 | 2.70 |
| 23500 | 40.4 | -19.3 | 0.90 | -33.35 | 6.99 | 3.52 | 2.66 |
| 24000 | 40.4 | -19.8 | 0.88 | -33.99 | 6.88 | 3.88 | 2.58 |
| 24500 | 40.4 | -19.5 | 0.91 | -33.89 | 7.01 | 3.93 | 2.51 |
| 25000 | 40.4 | -19.3 | 0.88 | -33.00 | 6.72 | 3.96 | 2.14 |
| 25500 | 40.5 | -20.4 | 0.89 | -34.07 | 6.90 | 3.66 | 2.22 |
| 26000 | 40.5 | -21.3 | 0.86 | -35.11 | 7.02 | 3.69 | 2.28 |
| 26500 | 40.5 | -21.1 | 0.90 | -35.20 | 7.15 | 3.91 | 2.36 |

**Sample calculation**

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table.
Table shows an extract of values.

## 7.4 ANTENNA EMCO 3160-10 (26.5 GHZ – 40 GHZ)

| Frequency | AF EMCO 3160-10 | Corr. | cable loss 1 (inside chamber) | cable loss 2 (outside chamber) | cable loss 3 (switch unit) | cable loss 4 (to receiver) | distance corr. (-20 dB/ decade) | $d_{Limit}$ (meas. distance (limit) | $d_{used}$ (meas. distance (used) |
|---|---|---|---|---|---|---|---|---|---|
| GHz | dB (1/m) | dB | dB | dB | dB | dB | dB | m | m |
| 26.5 | 43.4 | -11.2 | 4.4 | | | | -9.5 | 3 | 1.0 |
| 27.0 | 43.4 | -11.2 | 4.4 | | | | -9.5 | 3 | 1.0 |
| 28.0 | 43.4 | -11.1 | 4.5 | | | | -9.5 | 3 | 1.0 |
| 29.0 | 43.5 | -11.0 | 4.6 | | | | -9.5 | 3 | 1.0 |
| 30.0 | 43.5 | -10.9 | 4.7 | | | | -9.5 | 3 | 1.0 |
| 31.0 | 43.5 | -10.8 | 4.7 | | | | -9.5 | 3 | 1.0 |
| 32.0 | 43.5 | -10.7 | 4.8 | | | | -9.5 | 3 | 1.0 |
| 33.0 | 43.6 | -10.7 | 4.9 | | | | -9.5 | 3 | 1.0 |
| 34.0 | 43.6 | -10.6 | 5.0 | | | | -9.5 | 3 | 1.0 |
| 35.0 | 43.6 | -10.5 | 5.1 | | | | -9.5 | 3 | 1.0 |
| 36.0 | 43.6 | -10.4 | 5.1 | | | | -9.5 | 3 | 1.0 |
| 37.0 | 43.7 | -10.3 | 5.2 | | | | -9.5 | 3 | 1.0 |
| 38.0 | 43.7 | -10.2 | 5.3 | | | | -9.5 | 3 | 1.0 |
| 39.0 | 43.7 | -10.2 | 5.4 | | | | -9.5 | 3 | 1.0 |
| 40.0 | 43.8 | -10.1 | 5.5 | | | | -9.5 | 3 | 1.0 |

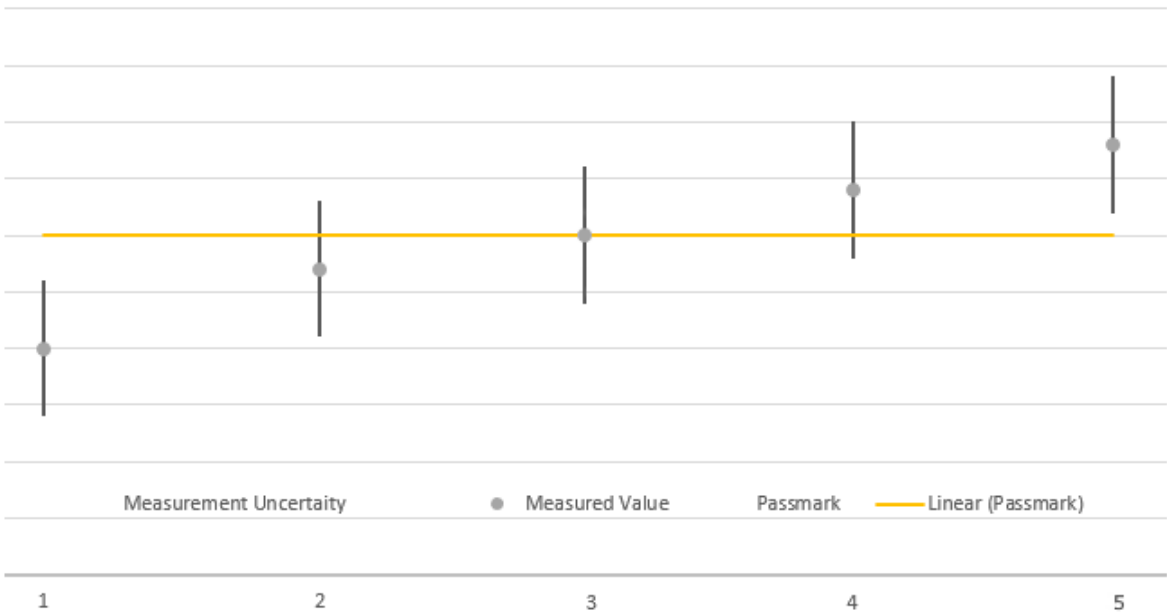
**Sample calculation**

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table.
distance correction = -20 * LOG ($d_{Limit}$/ $d_{used}$)
Linear interpolation will be used for frequencies in between the values in the table.
Table shows an extract of values.

# 8 MEASUREMENT UNCERTAINTIES

| Test Case | Parameter | Uncertainty |
|---|---|---|
| Conducted Emissions at AC mains | Voltage | ± 3.4 dB |
| Radiated Emissions | Field Strength | ± 5.5 dB |

The measurement uncertainties for all parameters are calculated with an expansion factor (coverage factor) k = 1.96. This means, that the true value is in the corresponding interval with a probability of 95 %.




The verdicts in this test report are given according the above diagram:

| Case | Measured Value | Uncertainty Range | Verdict |
|---|---|---|---|
| 1 | below pass mark | below pass mark | Passed |
| 2 | below pass mark | within pass mark | Passed |
| 3 | on pass mark | within pass mark | Passed |
| 4 | above pass mark | within pass mark | Failed |
| 5 | above pass mark | above pass mark | Failed |

That means, the laboratory applies, as decision rule (see ISO/IEC 17025:2017), the so-called shared risk principle.

# 9 PHOTO REPORT

Please see separate photo report.

**********END OF TEST REPORT**********