# EMC Test Report
# 2023-0221-EMC-TR-23-0162-V01

| | |
|---|---|
| Designation: | Instrument Cluster with immobilizer circuit |
| Model | FPK10-5C |
| Manufacturer: | Visteon Corporation |
| Serial No(s): | PWB26595 |
| FCC ID: | NT8-FPK105C |
| | |
| Regulation(s): | FCC 47 CFR Part 15 Subpart C |
| Measurement procedure(s): | ANSI C63.10:2013 |
| | |
| Test Plan: | Not provided |
| | |
| **Test Result:** | **Passed** |

| | | | |
|---|---|---|---|
| Date of issue: | 01.09.2023 | | Signature: |
| Version: | 01 | Technical Reviewer: | Markus Conrad<br>Lab Engineer EMC<br>Digitally signed by Markus Conrad<br>DN: cn=Markus Conrad gn=Markus Conrad c=DE Germany l=DE Germany o=Bureau Veritas Consumer Products Services Germany GmbH e=Markus.Conrad@bureauveritas.com<br>Reason: I am the author of this document<br>Location: Nuremberg, Germany<br>Date: 2023-09-01 12:48+02:00 |
| Date of receipt EUT: | 16.05.2023 | | |
| Performance date: | 30.05.2023 – 30.08.2023 | Report Reviewer: | Thomas Hufnagel<br>Test Engineer<br>Digitally signed by Thomas Hufnagel<br>Date: 2023.09.01 13:34:41 +02'00' |

Bundesnetzagentur

BNetzA-CAB-19/21-20

ilac-MRA

DAkkS Deutsche Akkreditierungsstelle D-PL-12024-06-04



Bureau Veritas
Consumer Products Services Germany GmbH
www.bureauveritas.de/cps
Phone: +49 (0)40 – 740 41 – 0

Schwerin
Wilhelm-Hennemann-Str. 8, 19061 Schwerin
cps-schwerin@bureauveritas.com

Tuerkheim
Businesspark A96, 86842 Tuerkheim
cps-tuerkheim@bureauveritas.com

Managing Director: Sebastian Doose, Stefan Kischka
VAT-No.: DE164793120
Reg.No.: Schwerin HRB 3564

Hamburg
Oehleckerring 40, 22419 Hamburg
cps-hamburg@bureauveritas.com

Nuremberg
Thurn-und-Taxis-Str. 18, 90411 Nuremberg
cps-nuernberg@bureauveritas.com

| | |
|---|---|
| **Client:** | Visteon Corporation<br>One Village Center Drive<br>Van Buren Township, MI, 48111 |
| **Test laboratory:** | Bureau Veritas Consumer Products Services Germany GmbH<br>Thurn-und-Taxis-Straße 18<br>D-90411 Nürnberg<br>Tel.: +49 40 74041 0 |
| **Test location:** | Bureau Veritas Consumer Products Services Germany GmbH<br>Thurn-und-Taxis-Straße 18<br>D-90411 Nürnberg |

| | |
|---|---|
| Laboratory accreditation no: | DakkS D-PL-12024-06-04<br>BNETZA-CAB-19/21-20 |
| FCC Designation Number: | DE0023 |
| FCC Test Firm Registration: | 366481 |

**Versions management:**

| | |
|---|---|
| V 01.00 | Initial release |

# Table of Contents

# 1 General

## 1.1 Purpose

This report documents the qualification testing for the Instrument Cluster with immobilizer circuit to FCC 47CFR Part 15 Subpart C. The system is referred to as the EUT from here on for the purpose of this report. All emission testing was performed per ANSI C63.10 (Procedures for Compliance Testing of Unlicensed Wireless Devices).

## 1.2 Requirements according to FCC 47 CFR Part 15 Subpart C

| Test Description | Regulation | Remarks | Test Result |
|---|---|---|---|
| AC powerline conducted emission | §15.207 | Not applicable, device is battery powered | --- |
| Electric field radiated emission 9kHz – 30 MHz | §15.209 | Refer to corresponding test chapter for details. | Pass |
| Output power measurement | §15.209 | Refer to corresponding test chapter for details. | Pass |
| Electric field radiated emission 30 – 1000 MHz | §15.209 | Refer to corresponding test chapter for details. | Pass |
| Electric field radiated emission above 1 GHz | §15.209 | Refer to corresponding test chapter for details. | Pass |
| Occupied Bandwidth | §2.1049 | Refer to corresponding test chapter for details. | Pass |

# 2 EUT Description

The following information and instructions of this chapter was provided by client.
The performance and statements of applicability of the tests is based on this information and this may therefore have an impact on the validity of the test verdict.

## 2.1 General Information

| | |
|---|---|
| Designation | Instrument Cluster with immobilizer circuit |
| Model | FPK10-5C |
| Manufacturer | Visteon Corporation |
| Serial No(s) | PWB26595 |
| Hardware version | HW32X, X=0-9 |
| Soft-/Firmware version | SW2YXX, XX=20-99, Y=5-9 |
| Device type | Table top |
| Equipment classification | Domestic environment |
| Highest internal frequency | IMX6 processor: 700-800 MHz |
| Supply voltage(s) | 12 V DC Battery powered |
| Supply voltage used for testing [1] | 12 V DC |

| Ports: | | | |
|---|---|---|---|
| Designation | Type | Shielding | Remarks |
| DC Mains | L, N | Unshielded | Battery powered |

| Test Plan: |
|---|
| Not provided. |

[1] If not otherwise specified in the corresponding test chapter

## 2.2 EUT description

Instrument Cluster with immobilizer circuit, to be installed in various customized housings. The unit intended to be supplied by a vehicle battery power system. The product provides connections to additional sensors and control units via analog and digital inputs or a CAN bus interface. The immobilizer circuit provides connection to an external transponder coil for key authentication.
The base station is an integrated circuit which communicates and transfers the data to the microcontroller (defined area where the key data is stored)
The Antenna Coil (La) is the interface to the immobilizer. The data exchange between the immobilizer and the coil is based on 125 kHz carrier frequency, ASK proprietary modulation.

## 2.3 Setup

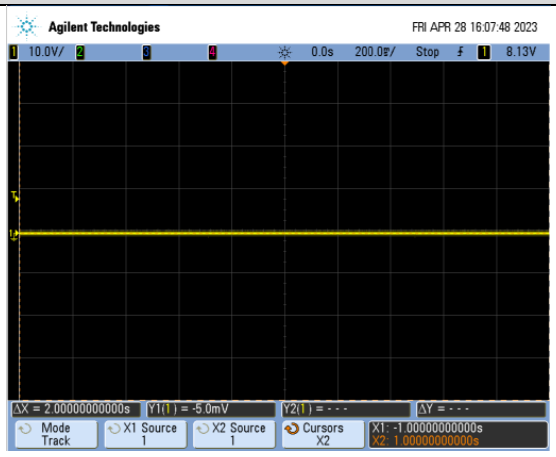
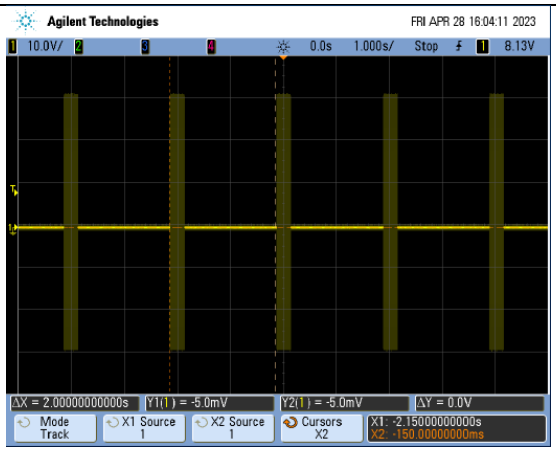
Details on radio technology:

| | |
|---|---|
| Technology | 125 kHz |
| RF type | Magnetic field antennas for immobilizer |
| Frequency range (band) | Min 116 kHz, Max= 134 kHz |
| Fundamental frequency | 125 kHz ±3% |
| Modulation scheme | ASK proprietary |
| Maximum radio output power: | 65 dBuA/m @10m |
| Operating voltage | DC 9-16 V, 13.5 V (typical vehicle battery) |
| Operating current | 2 A |
| Operating temperature range | -40° C to +80° C |
| Number of channels | 1 |
| Channel separation | Single channel operation |
| Antenna reference | Antenna |
| Antenna designation/Type | Costal Air Coil |
| Max. antenna gain | 0 dBi |
| Dimensions / weight | 341 x 160 x 80 mm / 0.800 kg TBC |
| Carlines: | VW Caddy, Ford City Van |

## 2.4 Grounding

The DUT was isolated against ground during the test.

## 2.5 Operating modes

| Mode | Description |
|---|---|
| **Mode 1** |  Test mode off |
| **Mode 2** |  Cyclic Mode |
| **Mode 3** |  Continuous Mode |

## 2.6 Modifications

None.

## 2.7 Ancillary equipment

Key Fob, see photo report.

# 3 Description of EMC test laboratory

## 3.1 Climatic conditions during measurements

The climatic conditions were within the following ranges.
For ESD testing, the conditions during the test were denoted in the corresponding chapter.

| | |
|---|---|
| Ambient temperature: | 15 – 35 °C |
| Relative humidity: | 30 – 60 % |
| Air pressure: | 860 – 1060 hPa |

## 3.2 Decision of conformity

If the standard or the customer defines no decision rule, the laboratory applies a decision rule following the “Binary Statement for Simple Acceptance Rule ($w$=0)” (chapter 4.2.1) of ILAC Guidelines on Decision Rules and Statements of Conformity (ILAC-G8:09/2019). If the measured value is at the limit value, it is evaluated as PASS. The client has agreed with application of the decision rule prior testing and demanded a statement of conformity by the test laboratory.

## 3.3 Measurement uncertainty

The table below shows the measurement uncertainties for each measurement method. The expanded uncertainty was calculated with worst case values over the complete frequency area.

| Measurement method | Parameter | Description | Exp. Uncertainty (k=2) |
|---|---|---|---|
| Radiated emission | 9 kHz – 1 GHz | Semi anechoic chamber | ± 5,3 dB |
| | 1 GHz – 6/18/26/40 GHz | Fully/Semi anechoic chamber | ± 4,7/ 4,4 dB |
| Conducted emission | 9 kHz - 150 kHz<br>150 kHz - 30 MHz | Semi anechoic chamber | ± 3,8 dB<br>± 3,4 dB |

# 4 Measurements acc. to FCC 47 CFR Part 15 Subpart C

## 4.1 Electric field radiated emission in the frequency range 9 kHz – 30 MHz

### 4.1.1 Overview

| | |
|---|---|
| DUT | Instrument Cluster with immobilizer circuit |
| Model | FPK10-5C |
| Serial No. | PWB26595 |
| Modification | None |
| Mode(s) | Mode 3: **Continuous Mode** (refer to chapter 2.5 for detailed information) |

| | **Test Parameter** | **Remarks** |
|---|---|---|
| Requirement(s) | §15.209 | |
| Test method | ANSI C63.10:2013 | |
| Limit | §15.209 | |
| Frequency Range | 9 kHz – 30 MHz | |
| Resolution Bandwidth | 200 Hz (9 kHz – 150 kHz)<br>9 kHz (150 kHz – 30 MHz) | |
| Detector (Final) | CISPR-Average (9-90 kHz & 110-490 kHz)<br>Quasipeak (others) | |
| Distance | 3 m | |
| Scan Heights | 1 m | |
| Polarizations | 2 | |
| Test site | Semi anechoic chamber (SAC) | |
| DUT Orientation(s) | 1 | |
| Supply Voltage | 12 V DC | Battery powered |

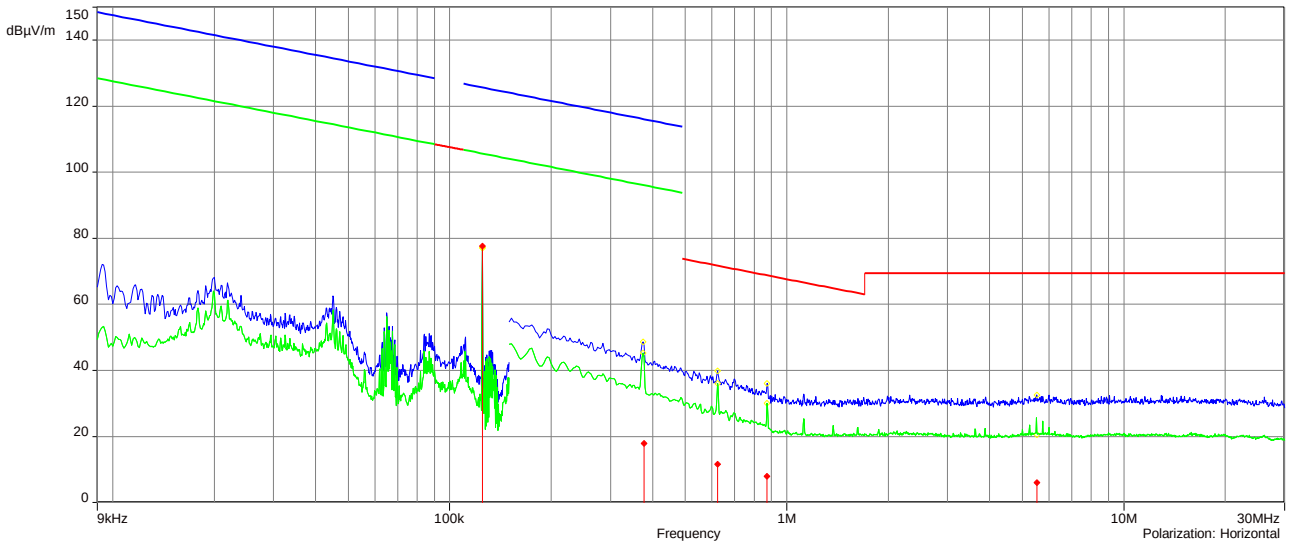
### 4.1.2 Result

| | |
|---|---|
| Test location | SAC |
| Test engineer | M. Conrad |
| Test Date | 30.08.2023 |
| Verdict | --- |

### 4.1.3 Test equipment

| Designation | Type | Manufacturer | Inventory No. | Cal. Date | Next Cal. |
|---|---|---|---|---|---|
| EMI test receiver | ESU40 | Rohde & Schwarz | E-003138 | 13.10.2022 | 13.10.2023 |
| Loop antenna | HFH2-Z2 | R & S | E-003542 | 26.10.2021 | 26.10.2023 |
| Measurement software | BAT-EMC | Nexio | V2022.0.9.0 | --- | --- |

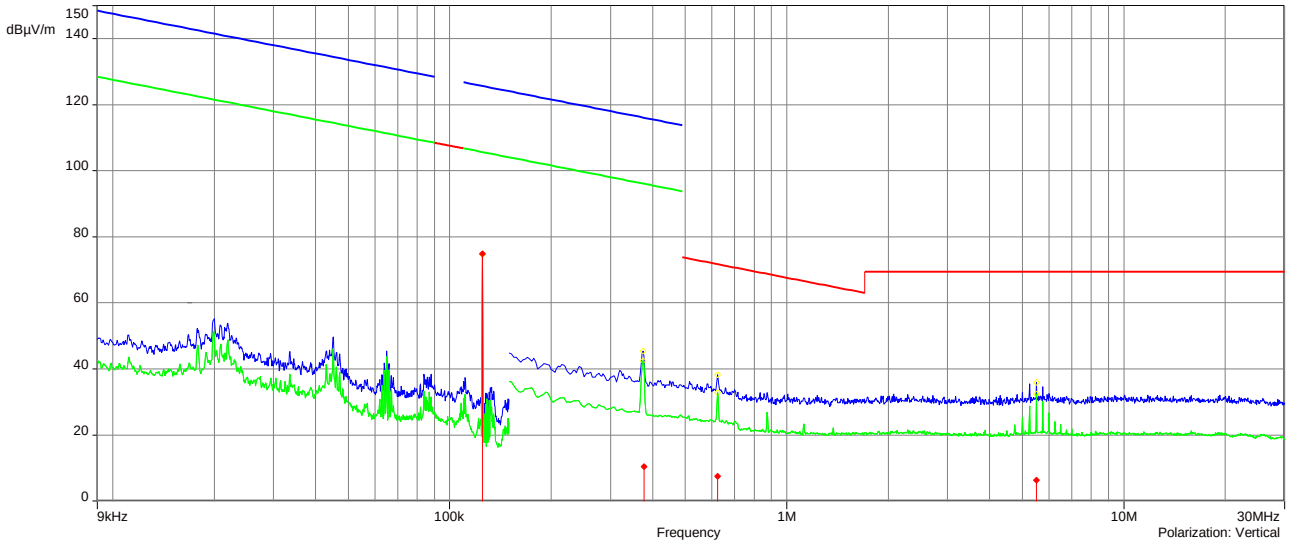
### 4.1.4 Detailed measurement data




| Frequency (MHz) | QP (dBµV/m) | Margin QP (dB) | AVG (dBµV/m) | Margin AV (dB) | Angle (°) | RBW (Hz) | Correction (dB) |
|---|---|---|---|---|---|---|---|
| 0.125* | 77.63 | - | 77.65 | -28,04 | 192.60 | 200 | 20.51 |
| 0.37675 | 17.88 | - | 15.16 | -80,97 | 184.60 | 9k | 20.46 |
| 0.62215 | 11.57 | -60.15 | 8.85 | - | 223.30 | 9k | 20.48 |
| 0.87235 | 7.94 | -60.86 | 4.76 | - | -11.70 | 9k | 20.50 |
| 5.5179 | 5.98 | -63.52 | 3.23 | - | 165.00 | 9k | 20.74 |

*TX Frequency, not subject to spurious emission testing.

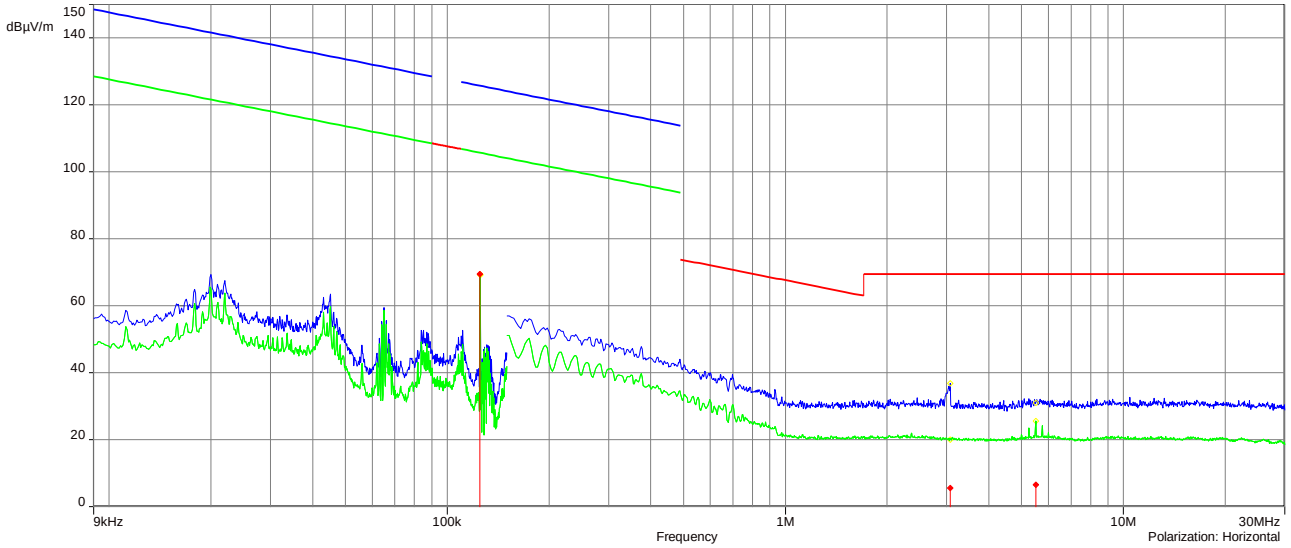
Measurement 1: Antenna position X




| Frequency (MHz) | QP (dBµV/m) | Margin QP (dB) | AVG (dBµV/m) | Margin AV (dB) | Angle (°) | RBW (Hz) | Correction (dB) |
|---|---|---|---|---|---|---|---|
| 0.125* | 74.86 | - | 74.87 | -30,82 | 274.70 | 200 | 20.51 |
| 0.37675 | 10.48 | - | 7.40 | -88,73 | 274.60 | 9k | 20.46 |
| 0.62255 | 7.45 | -64.28 | 4.58 | - | 258.30 | 9k | 20.48 |
| 5.4998 | 6.38 | -63.12 | 3.59 | - | 343.20 | 9k | 20.74 |

*TX Frequency, not subject to spurious emission testing.

Measurement 2: Antenna position Y

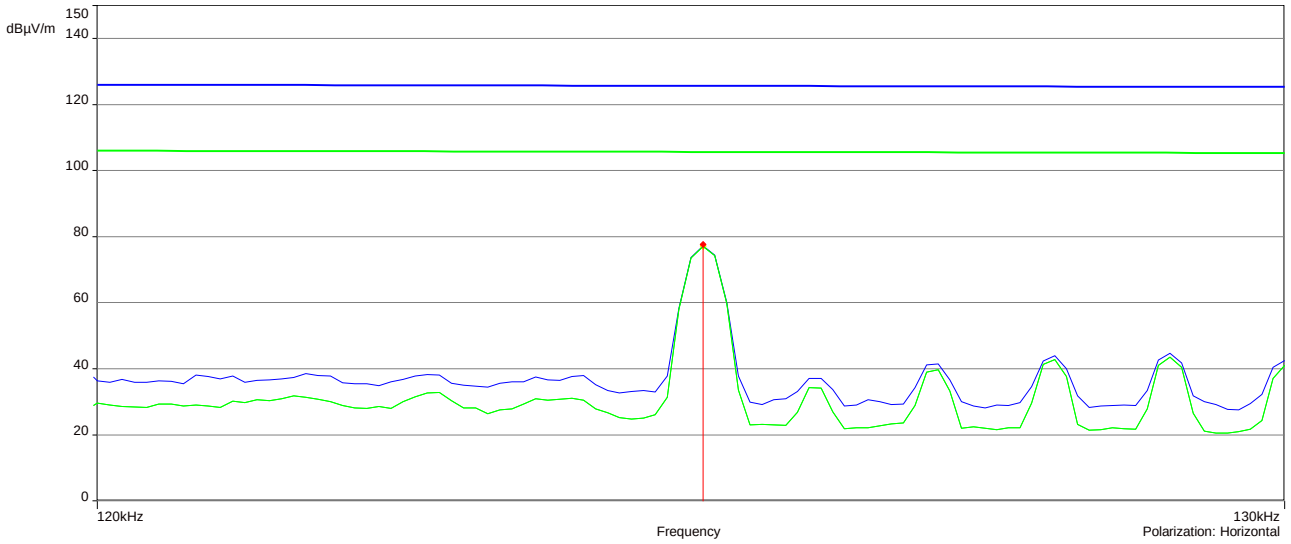



| Frequency (MHz) | QP (dBµV/m) | Margin QP (dB) | AVG (dBµV/m) | Margin AV (dB) | Angle (°) | RBW (Hz) | Correction (dB) |
|---|---|---|---|---|---|---|---|
| 0.12505* | 69.50 | - | 69.55 | -69,63 | 188.40 | 200 | 20.51 |
| 3.0745 | 5.60 | -63.90 | 2.74 | - | 88.80 | 9k | 20.75 |
| 5.50175 | 6.50 | -63.00 | 3.38 | - | -9.60 | 9k | 20.74 |

*TX Frequency, not subject to spurious emission testing.

Measurement 3: Antenna position Z

### 4.1.5 Output power measurement




| Frequency (MHz) | AVG (dBµV/m) | Margin AV (dB) | Angle (°) | RBW (Hz) | Correction (dB) |
|---|---|---|---|---|---|
| 0.125 | 77.65 | -28,04 | 192.60 | 200 | 20.51 |

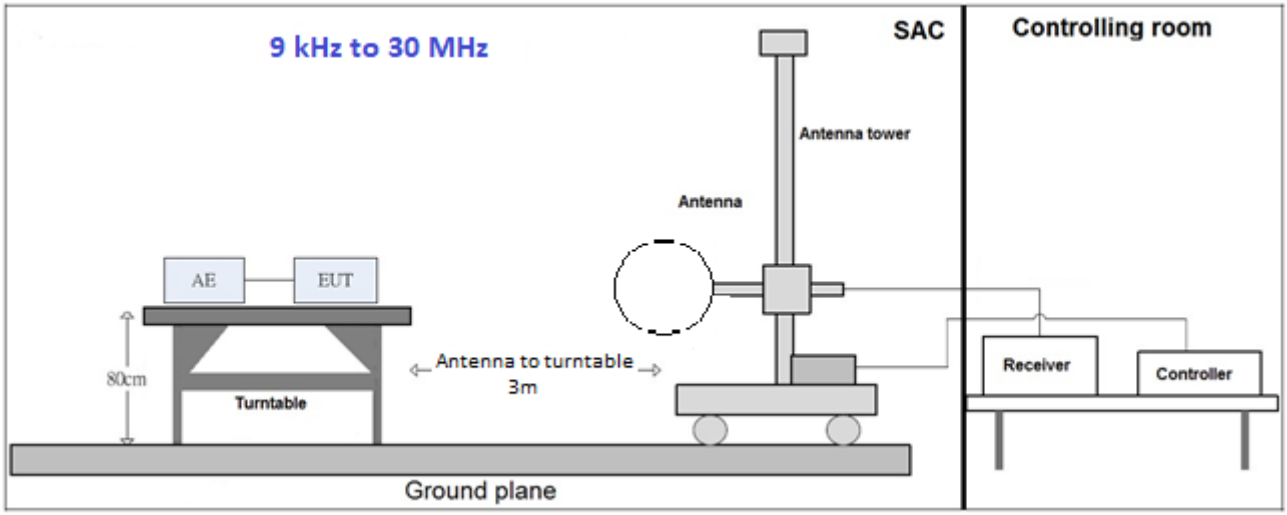
Measurement 4: Peak Output Power

### 4.1.6 Measurement Procedure

The measurements were made in the operating mode, with the EUT producing the maximum emission, consistent with normal applications. The EUT load was adjusted within the range specified by manufacturer in order to maximize the emission.

For this test, the EUT was placed on the turntable at a distance of 3 m from the receive antenna. The EUT was positioned on a 10 cm high wooden pallet or on a nonconductive table. The connecting lines to the EUT were fed in from above (as in the installation). The system ground was connected to the ground plane. The turntable was connected directly to the ground system of the test chamber.

While EUT power is on, an operator manually scans the selected frequency range using an EMI test receiver to identify signals being generated by the EUT. At this time the operator determines which signals generated by EUT are significant enough to assign to the final data list in the computer. The signals on the final list are automatically characterized while the antenna is in both horizontal and vertical polarity. The tower and turntable are controlled by the operator. The maximized signal indication on the receiver is then combined with the calibration factors, cable insertion loss and the proper antenna factors to provide the emission level in dB µV/m which is compared directly with the requirement stored in the program libraries. The maximum RFI field strength was determined during the measurement by rotating the turntable (±180 degrees).




**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-Maxhold / Quasipeak
- Frequency range: 9 kHz – 30 MHz
- Frequency steps: 100 Hz / 2.5 kHz
- IF–Bandwidth: 200 Hz / 9 kHz
- Measuring time / Frequency step: 10 ms
- Turntable angle range: –180° to 180°
- Turntable step size: 30°

- Polarisation: parallel and axial

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 ± 30° around this value. 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 also slowly vary by ± 100 cm around the antenna height determined. 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 – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 200 Hz / 9 kHz
- Measuring time: 10 ms
- Turntable angle range: ± 30 ° around the determined value
- Antenna polarisation: max. value determined in step 1

**Step 3:** Final measurement with QP / AV detector

With the settings determined in step 3, the final measurement will be performed:

EMI receiver settings for step 4:

- Detector: Quasi-Peak / Average (depending on frequency acc. to §15.209 (d))
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 200 Hz / 9 kHz
- Measuring time: 1 s

After the 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.

### 4.1.7 Field Strength Calculations

**FS** = SA + AF + CL

Where:

**FS** = Total Field Strength
**SA** = EMC test receiver Reading
**AF** = Antenna Factor
**CL** = Cable Loss

## 4.2 Electric field radiated emission in the frequency range 30 – 1000 MHz

### 4.2.1 Overview

| | |
|---|---|
| EUT | Instrument Cluster with immobilizer circuit |
| Model | FPK10-5C |
| Serial No. | PWB26595 |
| Modification | None |
| Mode(s) | Mode 3: **Continuous Mode** (refer to chapter 2.5 for detailed information) |

| | **Test Parameter** | **Remarks** |
|---|---|---|
| Requirement(s) | §15.209 | |
| Test method | ANSI C63.10:2013 | |
| Limit | §15.209 | |
| Frequency range | 30 – 1000 MHz | |
| Resolution bandwidth | 120 kHz | |
| Detector (Final) | Quasipeak | |
| Distance | 3 m | |
| Scan heights | 1 – 4 m | |
| Polarizations | horizontal & vertical | |
| Test site | Semi anechoic chamber (SAC) | |
| EUT orientation(s) | 1 | EUT has a defined orientation |
| Supply voltage | 12 V DC | Battery powered |

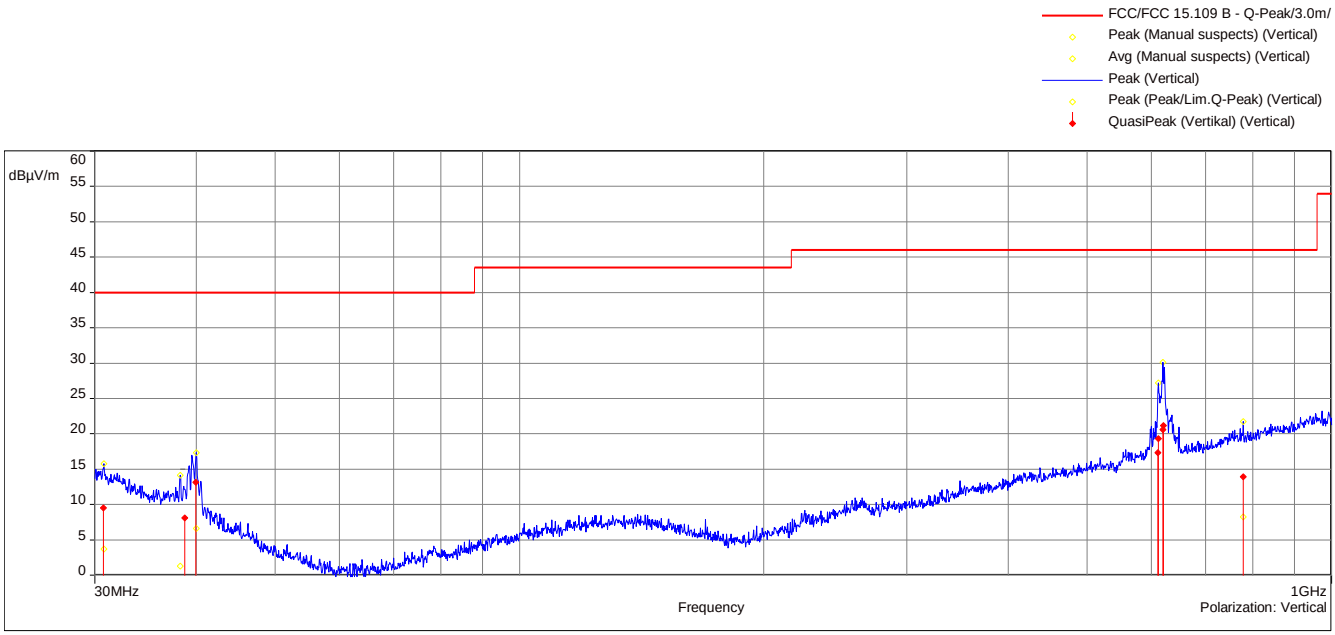
### 4.2.2 Result

| | |
|---|---|
| Test location | SAC |
| Test engineer | M. Thomas |
| Test date | 30.05.2023 |
| Verdict | Pass |

### 4.2.3 Test equipment

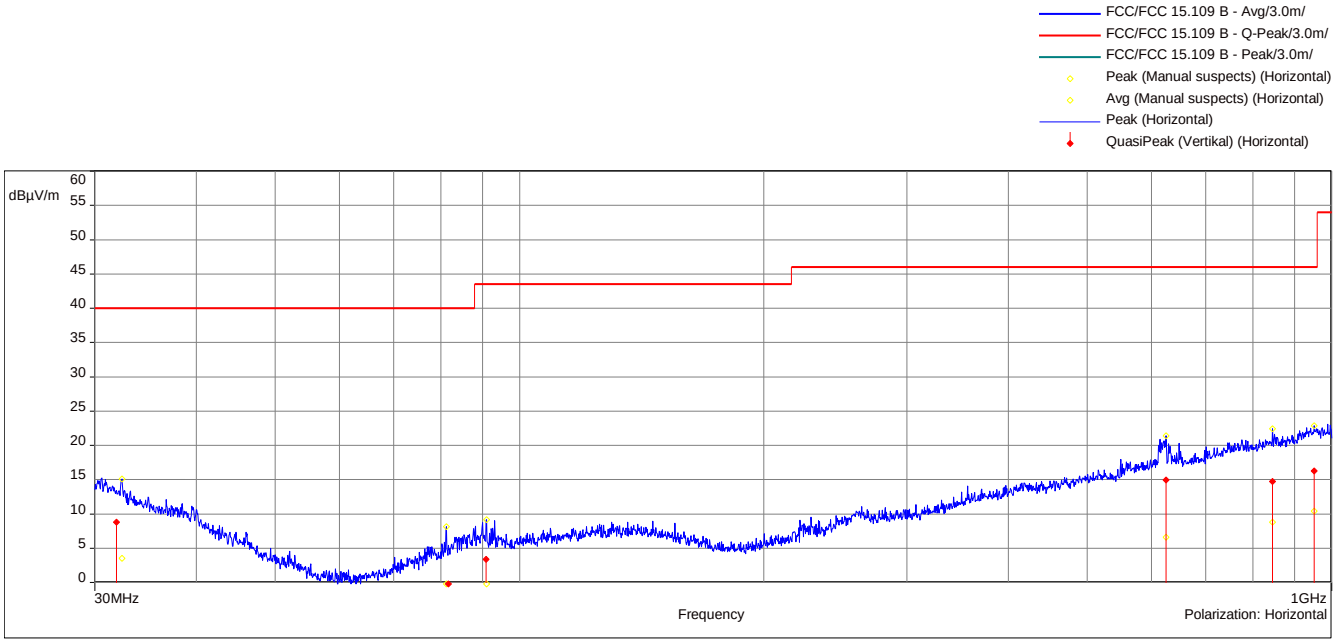
| Designation | Type | Manufacturer | Inventory No. | Cal. Date | Next Cal. |
|---|---|---|---|---|---|
| EMI test receiver | ESU40 | Rohde & Schwarz | E-003138 | 13.10.2022 | 13.10.2023 |
| Antenna | CBL 6111 | Chase | E-003226 | 19.02.2021 | 19.02.2024 |
| Preamplifier | AM1431 | Miteq | E-003365 | 21.10.2022 | 21.10.2023 |
| Measurement software | BAT-EMC | Nexio | V2022.0.9.0 | --- | --- |

### 4.2.4 Detailed measurement data




| Frequency (MHz) | QuasiPeak (dBµV/m) | Margin (dB) | Limit (dBµV/m) | Angle (°) | Height (m) | Polarization | RBW (Hz) | Correction (dB) |
|---|---|---|---|---|---|---|---|---|
| 30.76 | 9.51 | 30.49 | 40.00 | -62.90 | 2.68 | Vertical | 120k | -18.05 |
| 38.74 | 8.09 | 31.91 | 40.00 | -157.50 | 1.00 | Vertical | 120k | -22.35 |
| 39.97 | 13.16 | 26.84 | 40.00 | 42.60 | 1.00 | Vertical | 120k | -23.11 |
| 611.08 | 17.31 | 28.69 | 46.00 | -173.20 | 2.04 | Vertical | 120k | -14.38 |
| 612.04 | 19.31 | 26.69 | 46.00 | -175.10 | 1.00 | Vertical | 120k | -14.35 |
| 619.6 | 20.63 | 25.37 | 46.00 | -158.30 | 1.81 | Vertical | 120k | -14.19 |
| 620.59 | 21.18 | 24.82 | 46.00 | -160.80 | 2.06 | Vertical | 120k | -14.17 |
| 778.45 | 13.92 | 32.08 | 46.00 | -112.30 | 2.68 | Vertical | 120k | -12.10 |

Measurement 5: Vertical polarization




| Frequency (MHz) | QuasiPeak (dBµV/m) | Margin (dB) | Limit (dBµV/m) | Angle (°) | Height (m) | Polarization | RBW (Hz) | Correction (dB) |
|---|---|---|---|---|---|---|---|---|
| 31.9 | 8.79 | 31.21 | 40.00 | -85.80 | 3.91 | Horizontal | 120k | -18.73 |
| 81.7 | -0.46 | 40.46 | 40.00 | 110.10 | 1.70 | Horizontal | 120k | -29.24 |
| 90.97 | 3.41 | 40.09 | 43.50 | -101.90 | 3.26 | Horizontal | 120k | -28.01 |
| 625.57 | 14.96 | 31.04 | 46.00 | -16.30 | 1.47 | Horizontal | 120k | -14.07 |
| 844.9 | 14.75 | 31.25 | 46.00 | -122.40 | 3.25 | Horizontal | 120k | -11.45 |
| 951.46 | 16.28 | 29.72 | 46.00 | 48.90 | 2.94 | Horizontal | 120k | -9.87 |

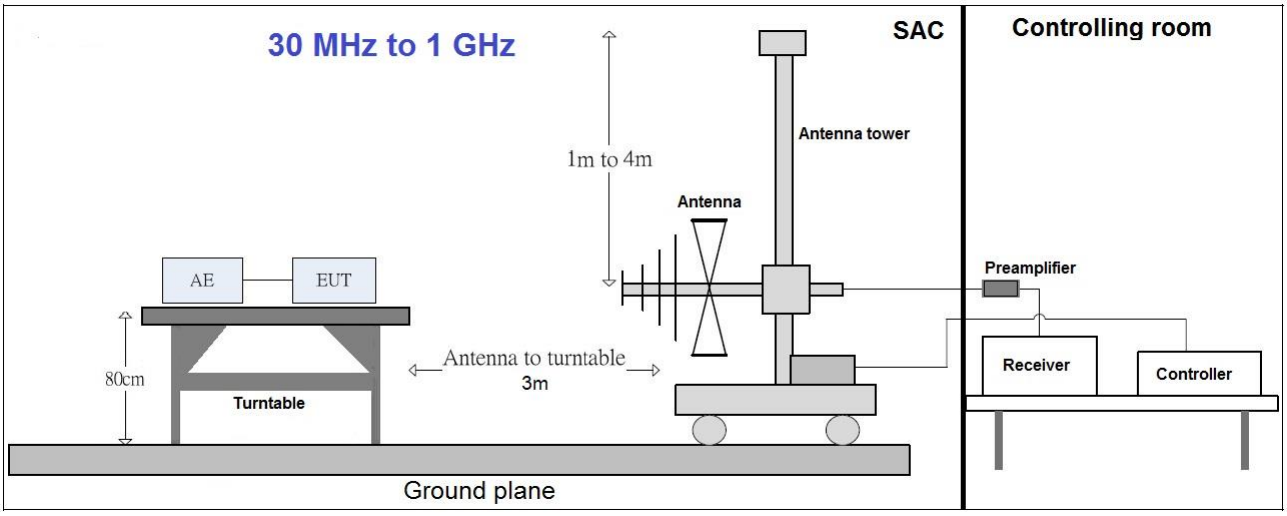
Measurement 6: Horizontal polarization

### 4.2.5 Measurement procedure

The measurements were made in the operating mode, with the EUT producing the maximum emission, consistent with normal applications. The EUT load was adjusted within the range specified by manufacturer in order to maximize the emission.

For this test, the EUT was placed on the turntable at a distance of 3m or 10 m (depending from the class B or A) from the receive antenna. The EUT was positioned on a 10 cm high wooden pallet or on a nonconductive table. The connecting lines to the EUT were fed in from above (as in the installation). The system ground was connected to the ground plane. The turntable was connected directly to the ground system of the test chamber.

While EUT power is on, an operator manually scans the selected frequency range using an EMI test receiver to identify signals being generated by the EUT. At this time the operator determines which signals generated by EUT are significant enough to assign to the final data list in the computer. The signals on the final list are automatically characterized while the antenna is in both horizontal and vertical polarity. The tower and turntable are controlled by the operator. The maximized signal indication on the receiver is then combined with the calibration factors, cable insertion loss and the proper antenna factors to provide the emission level in dB µV/m which is compared directly with the requirement stored in the program libraries. The maximum RFI field strength was determined during the measurement by rotating the turntable (±180 degrees) and varying the height of the receive antenna (h = 1 ... 4 m).



**Step 1:** Preliminary scan
This is a preliminary test to identify the highest amplitudes relative to the limit.
Settings for step 1:
- Antenna distance: 3m or 10 m (depending from the class B or class A)
- Detector: Peak-Maxhold / Quasipeak (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 180°
- Turntable step size: 15°
- Height variation range: 1 – 4 m
- Height variation step size: 1 m
- Polarization: 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 ± 15° around this value. 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 also slowly vary from 1m to 4 m heigh. 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 – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100 ms
- Turntable angle range: ± 15 ° around the determined value
- Antenna Polarization: max. value determined in step 1

**Step 3:** Final measurement with QP detector
With the settings determined in step 3, the final measurement will be performed:
EMI receiver settings for step 4:
- Detector: Quasi-Peak
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 1 s

After the 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.

### 4.2.6 Field Strength Calculations

**FS** = SA + AF + CL

Where:

**FS** = Total field strength
**SA** = EMC test receiver reading
**AF** = Antenna factor
**CL** = Cable loss

## 4.1 Electric field radiated emission in the frequency range 1 – 18 GHz

### 4.1.1 Overview

| | |
|---|---|
| EUT | Instrument Cluster with immobilizer circuit |
| Model | FPK10-5C |
| Serial No. | PWB26595 |
| Modification | None |
| Mode(s) | Mode 3: **Continuous Mode** (refer to chapter 2.5 for detailed information) |

| | **Test Parameter** | **Remarks** |
|---|---|---|
| Requirement(s) | §15.109 | |
| Test method | ANSI C63.4:2014 + ANSI C63.4a:2017 | |
| Limit | Class B | |
| Frequency range | 1 – 18 GHz | 5th harmonic of the highest frequency acc. to §15.33(b) |
| Resolution bandwidth | 1 MHz | |
| Detector (Final) | Peak / Average | |
| Distance | 3 m | |
| Scan heights | 1 – 4 m | |
| Polarizations | horizontal & vertical | |
| Test site | Semi anechoic chamber (SAC) with rf absorbers on floor | |
| EUT orientation(s) | 1 | EUT has a defined orientation |
| Supply voltage | 12 V DC | Battery powered |

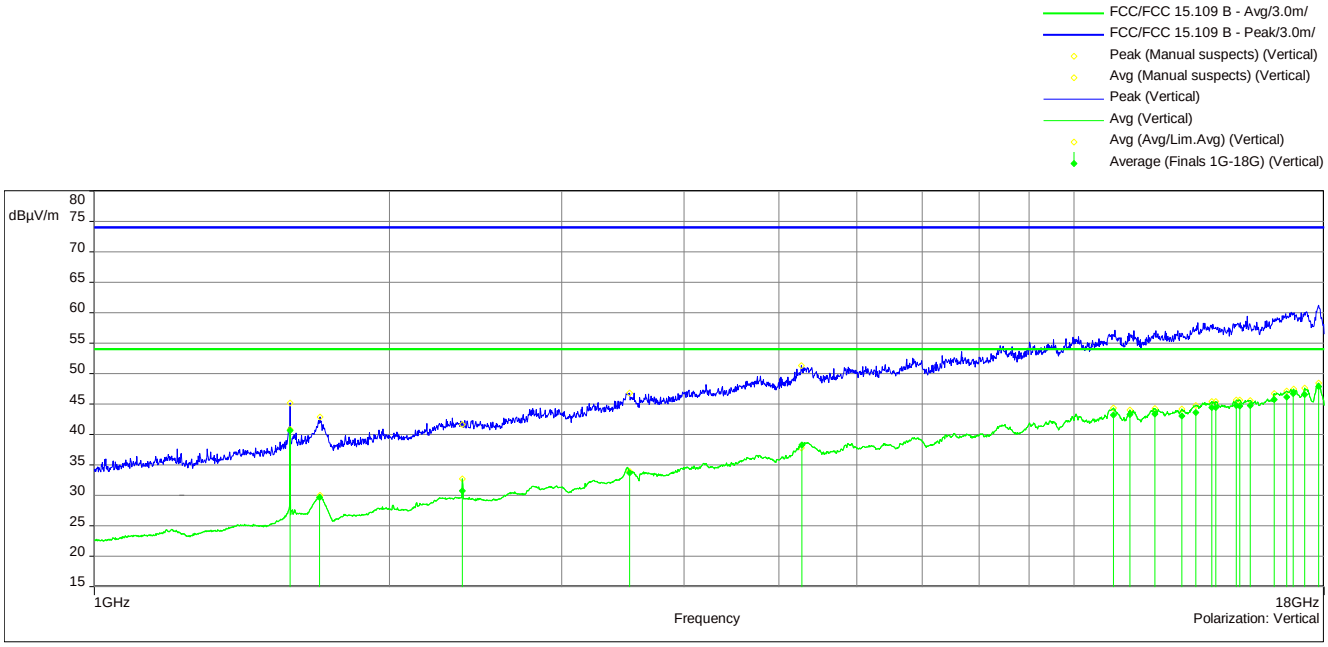
### 4.1.2 Result

| | |
|---|---|
| Test location | SAC |
| Test engineer | G. Gass |
| Test date | 29.06.2023 |
| Verdict | Pass |

### 4.1.3 Test equipment

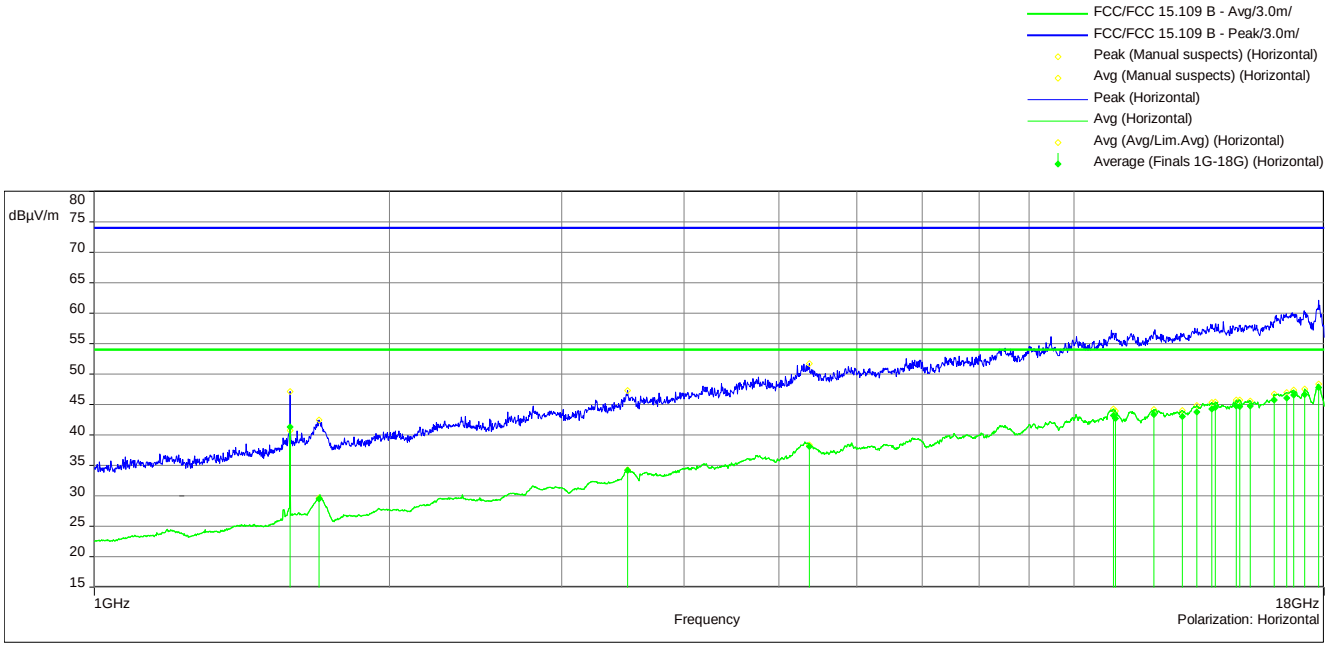
| Designation | Type | Manufacturer | Inventory No. | Cal. Date | Next Cal. |
|---|---|---|---|---|---|
| EMI test receiver | ESU40 | Rohde & Schwarz | E-003138 | 13.10.2022 | 13.10.2023 |
| Antenna | HL025 | Rohde & Schwarz | E-003259 | 12.01.2022 | 12.01.2023 |
| Preamplifier | AFS4-00102000 | Miteq | E-003633 | 20.10.2022 | 20.10.2023 |
| Antenna | MWH-1826/B | ARA Inc. | E-003233 | 09.10.2020 | 09.10.2023 |
| Antenna | MWH-2640/B | ARA Inc. | E-003234 | 09.10.2020 | 09.10.2023 |
| Preamplifier | AMP-2000-43000-50-10-2.9-F | TTE Europe | E-003999 | 19.10.2022 | 19.10.2023 |
| Preamplifier | BZ32-01001800-232360-282323 | B&Z Technologies | E-004002 | 19.10.2022 | 19.10.2023 |
| Preamplifier | AMP-18000-40000-60-18-2.9-F | TTE Europe | E-004003 | 19.10.2022 | 19.10.2023 |
| Measurement software | BAT-EMC | Nexio | V2022.0.23.0 | --- | --- |

### 4.1.4 Detailed measurement data from 1 GHz to 18 GHz




| Frequency (MHz) | Average (dBµV/m) | Margin Avg (dB) | LIMIT AV (dBµV/m) | Height (m) | Angle (°) | Polarization | RBW (Hz) | Correction (dB) |
|---|---|---|---|---|---|---|---|---|
| 1584 | 40.66 | 13.34 | 54.00 | 1.19 | -170.10 | Vertical | 1M | 8.55 |
| 1698.75 | 29.70 | 24.30 | 54.00 | 4.00 | -56.80 | Vertical | 1M | 12.02 |
| 2376 | 30.76 | 23.24 | 54.00 | 1.00 | -4.50 | Vertical | 1M | 12.72 |
| 3517 | 33.66 | 20.34 | 54.00 | 2.15 | -93.00 | Vertical | 1M | 18.00 |
| 5271.75 | 38.25 | 15.75 | 54.00 | 3.17 | 150.00 | Vertical | 1M | 21.63 |
| 10968.25 | 43.22 | 10.78 | 54.00 | 1.02 | -41.30 | Vertical | 1M | 30.53 |
| 11406.25 | 43.27 | 10.73 | 54.00 | 2.76 | -105.00 | Vertical | 1M | 30.00 |
| 12089.75 | 43.40 | 10.60 | 54.00 | 1.15 | 135.00 | Vertical | 1M | 30.33 |
| 12887.75 | 43.08 | 10.92 | 54.00 | 2.58 | 0.10 | Vertical | 1M | 29.83 |
| 13319.75 | 43.63 | 10.37 | 54.00 | 2.94 | -163.10 | Vertical | 1M | 30.38 |
| 13817.75 | 44.44 | 9.56 | 54.00 | 1.29 | 82.90 | Vertical | 1M | 31.02 |
| 13950 | 44.40 | 9.60 | 54.00 | 2.49 | -15.50 | Vertical | 1M | 31.03 |
| 14640.25 | 44.73 | 9.27 | 54.00 | 2.48 | -16.90 | Vertical | 1M | 31.89 |
| 14760.5 | 44.69 | 9.31 | 54.00 | 1.99 | 41.00 | Vertical | 1M | 31.75 |
| 15138.25 | 44.76 | 9.24 | 54.00 | 1.56 | 63.30 | Vertical | 1M | 31.72 |
| 16008.5 | 45.78 | 8.22 | 54.00 | 1.05 | 125.50 | Vertical | 1M | 32.95 |
| 16475.25 | 46.12 | 7.88 | 54.00 | 2.46 | 179.90 | Vertical | 1M | 33.33 |
| 16746.25 | 46.77 | 7.23 | 54.00 | 1.89 | 121.50 | Vertical | 1M | 33.76 |
| 17194.75 | 46.57 | 7.43 | 54.00 | 1.19 | 180.00 | Vertical | 1M | 33.54 |
| 17767.5 | 47.89 | 6.11 | 54.00 | 2.86 | -31.50 | Vertical | 1M | 34.52 |

Measurement 7: Vertical polarization




| Frequency (MHz) | Average (dBµV/m) | Margin Avg (dB) | LIMIT AV (dBµV/m) | Height (m) | Angle (°) | Polarization | RBW (Hz) | Correction (dB) |
|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Average (dBµV/m) | Margin VA | LIMIT AV (dBµV/m) | Höhe | Winkel | Pol | RBW | Correction (dB) |
| 1584 | 41.31 | 12.69 | 54.00 | 1.00 | 2.90 | Horizontal | 1M | 8.55 |
| 1695 | 29.51 | 24.49 | 54.00 | 3.32 | -164.20 | Horizontal | 1M | 11.82 |
| 3503.25 | 34.22 | 19.78 | 54.00 | 2.02 | -30.20 | Horizontal | 1M | 17.97 |
| 5369.75 | 38.11 | 15.89 | 54.00 | 3.16 | -131.70 | Horizontal | 1M | 21.64 |
| 10968 | 43.19 | 10.81 | 54.00 | 3.20 | -108.60 | Horizontal | 1M | 30.53 |
| 11015.5 | 42.67 | 11.33 | 54.00 | 1.20 | -6.30 | Horizontal | 1M | 30.32 |
| 12059.75 | 43.40 | 10.60 | 54.00 | 2.04 | 33.30 | Horizontal | 1M | 30.14 |
| 12894.75 | 43.02 | 10.98 | 54.00 | 3.95 | 26.80 | Horizontal | 1M | 29.81 |
| 13351.75 | 43.78 | 10.22 | 54.00 | 1.00 | -45.10 | Horizontal | 1M | 30.47 |
| 13824.25 | 44.28 | 9.72 | 54.00 | 1.35 | 128.00 | Horizontal | 1M | 30.97 |
| 13932.5 | 44.50 | 9.50 | 54.00 | 3.43 | 146.80 | Horizontal | 1M | 30.95 |
| 14640.5 | 44.74 | 9.26 | 54.00 | 2.67 | -89.90 | Horizontal | 1M | 31.90 |
| 14760.75 | 44.67 | 9.33 | 54.00 | 2.73 | 122.40 | Horizontal | 1M | 31.75 |
| 15138.75 | 44.80 | 9.20 | 54.00 | 1.53 | -15.00 | Horizontal | 1M | 31.72 |
| 16002.25 | 45.77 | 8.23 | 54.00 | 2.81 | -144.60 | Horizontal | 1M | 32.97 |
| 16493 | 46.08 | 7.92 | 54.00 | 3.83 | 85.90 | Horizontal | 1M | 33.37 |
| 16747.5 | 46.52 | 7.48 | 54.00 | 1.26 | 166.10 | Horizontal | 1M | 33.77 |
| 17191.5 | 46.61 | 7.39 | 54.00 | 3.24 | 62.80 | Horizontal | 1M | 33.50 |
| 17773.75 | 47.82 | 6.18 | 54.00 | 2.88 | 90.00 | Horizontal | 1M | 34.53 |

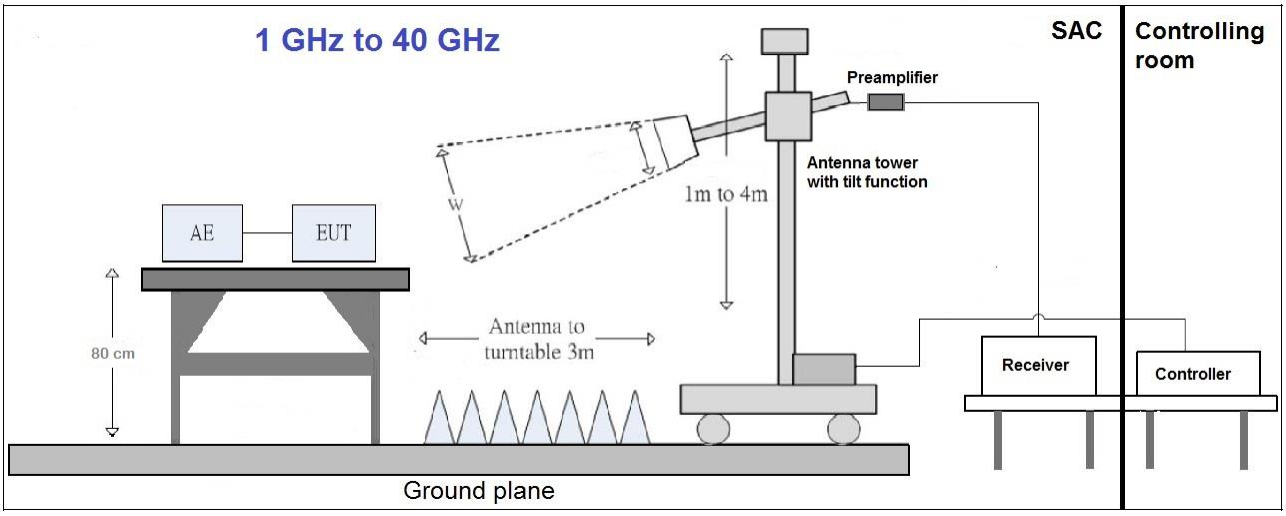
Measurement 8: Horizontal polarization

### 4.1.5 Measurement procedure

The measurements were made in the operating mode, with the EUT producing the maximum emission, consistent with normal applications. The EUT load was adjusted within the range specified by manufacturer in order to maximize the emission.

For this test, the EUT was placed on the turntable at a distance of 3 m from the receive antenna. The EUT was positioned on a 10 cm high wooden pallet or on a 80cm-non-conductive table. The connecting lines to the EUT were fed in from above (as in the installation). The system ground was connected to the ground plane. The turntable was connected directly to the ground system of the test chamber.

While EUT power is on, an operator manually scans the selected frequency range using an EMI test receiver to identify signals being generated by the EUT. At this time the operator determines which signals generated by EUT are significant enough to assign to the final data list in the computer. The signals on the final list are automatically characterized while the antenna is in both horizontal and vertical polarity. The tower and turntable are controlled by the operator. The maximized signal indication on the receiver is then combined with the calibration factors, cable insertion loss and the proper antenna factors to provide the emission level in dB µV/m which is compared directly with the requirement stored in the program libraries. The maximum RFI field strength was determined during the measurement by rotating the turntable (±180 degrees) and varying the height of the receive antenna (h = 1 ... 4 m).




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

**Step 1:**
The Equipment Under Test (EUT) was set up on a non-conductive support at 0.8 m height in the semi-anechoic chamber. Absorbers are placed around and between the turn table and the antenna tower.
The turn table step size (azimuth angle) for the preliminary measurement is 15 °.

**Step 2:**
The maximum RFI field strength was determined during the measurement by rotating the turntable (±180 degrees) and varying the height of the receive antenna (h = 1 ... 4 m) with an additional tilt function of the antenna. The turn table azimuth will slowly vary by ± 15°.
EMI receiver settings (for all steps):
- Detector: Peak, Average
- IF Bandwidth = 1 MHz

**Step 3:**
Spectrum analyzer settings for step 3:
- Detector: Peak / Average
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 1 MHz
- Measuring time: 1 s

### 4.1.6 Field Strength Calculations

**FS** = SA + AF + CL

Where:
**FS** = Total Field Strength
**SA** = EMC test receiver Reading
**AF** = Antenna Factor
**CL** = Cable Loss

## 4.2 Occupied Bandwidth

### 4.2.1 Overview

| | |
|---|---|
| DUT | Instrument Cluster with immobilizer circuit |
| Model | FPK10-5C |
| Serial No. | PWB26595 |
| Modification | None |
| Mode(s) | Transmission mode (refer to chapter 2.5 for detailed information) |

| | **Test Parameter** | **Remarks** |
|---|---|---|
| Requirement(s) | §2.1049 | |
| Test method | ANSI C63.10:2013 | |
| Operating frequency | 125 kHz | |
| Test site | Calibration Laboratory | |
| Supply Voltage | 12 V DC | Battery powered |

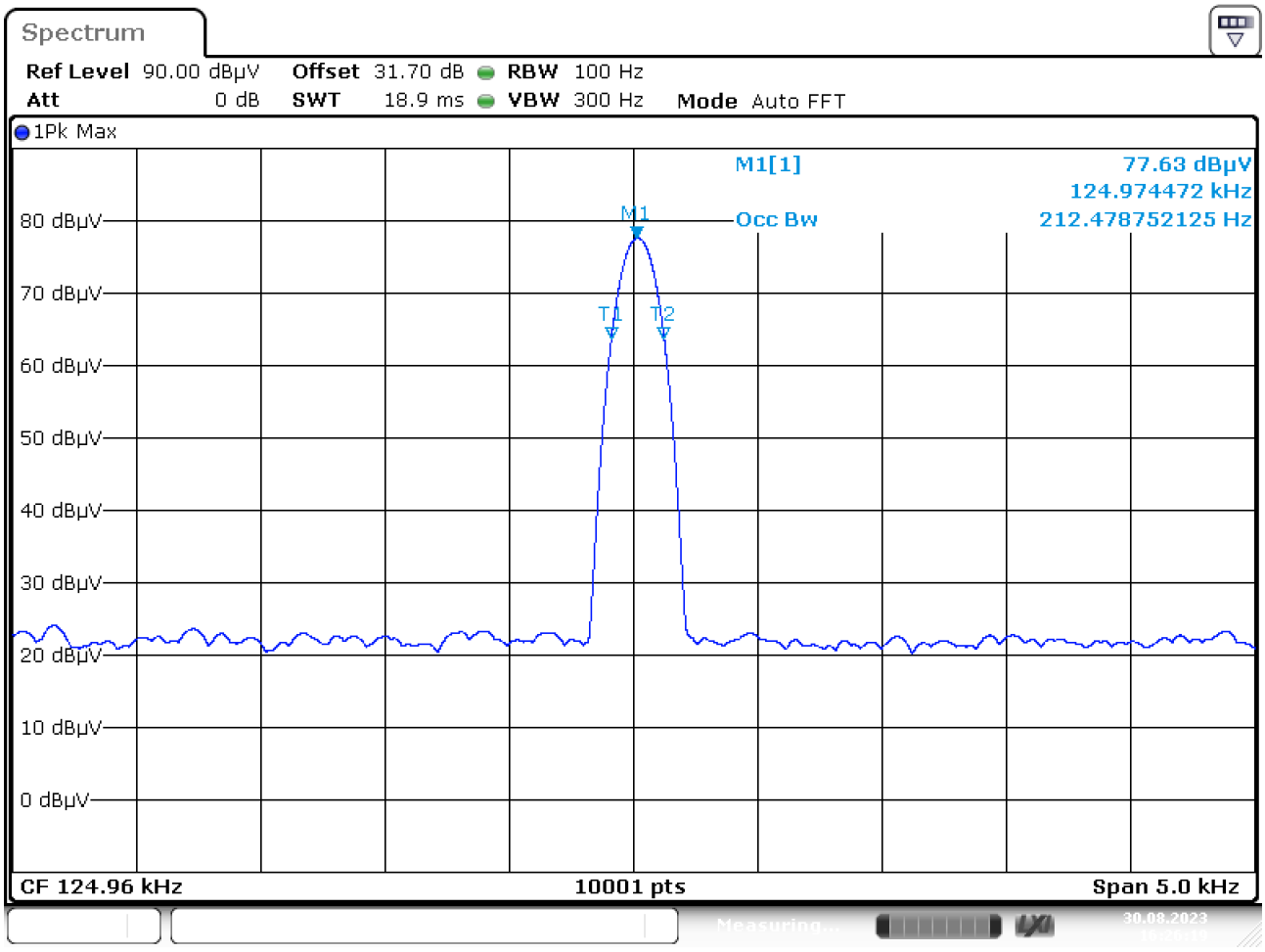
### 4.2.2 Result

| | |
|---|---|
| Test location | SAC |
| Test engineer | T. Hufnagel |
| Test Date | 30.08.2023 |
| Verdict | --- |

### 4.2.3 Test equipment

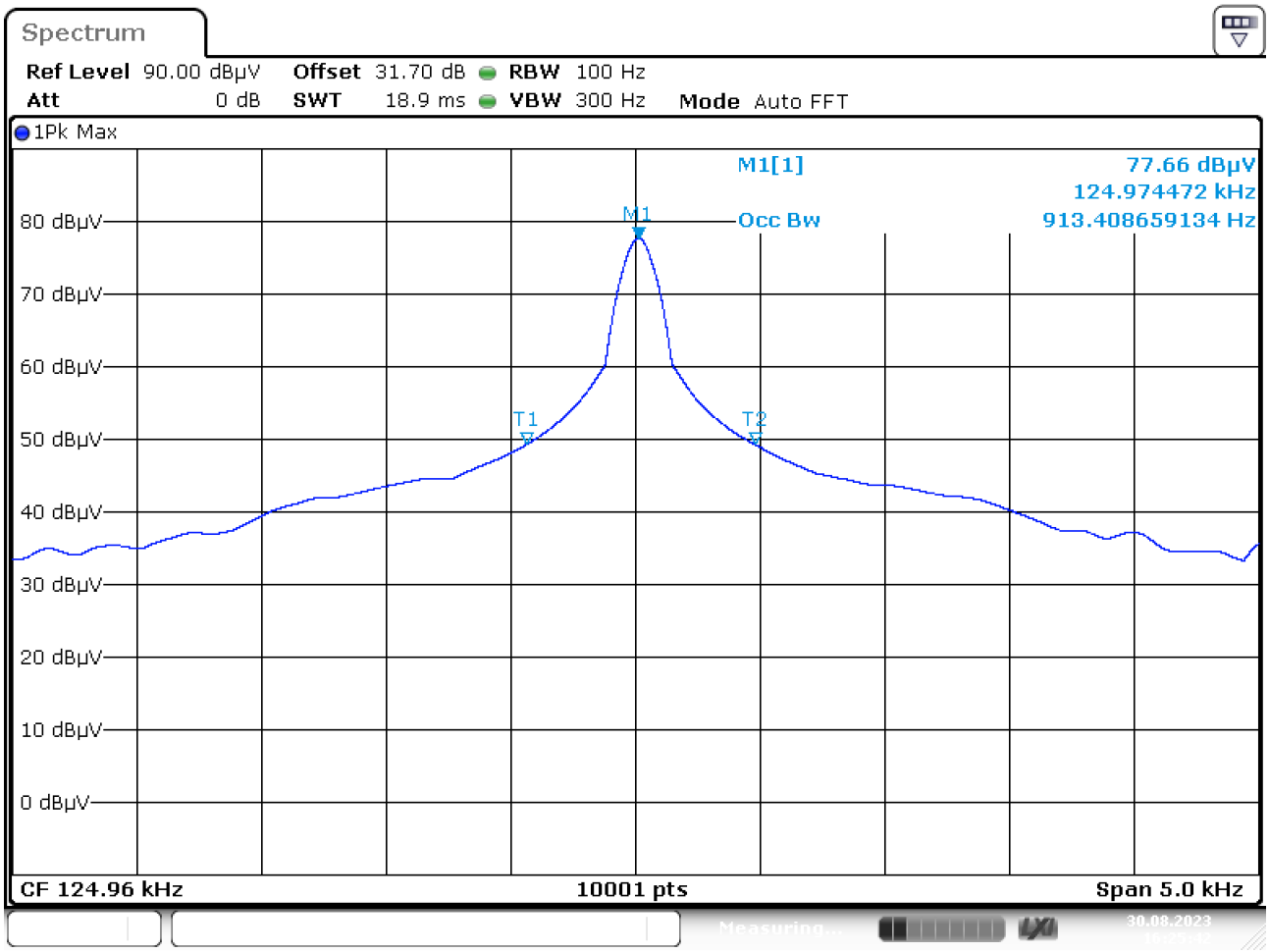
| Designation | Type | Manufacturer | Inventory No. | Cal. Date | Next Cal. |
|---|---|---|---|---|---|
| Spectrum analyzer | FSV40 | Rohde & Schwarz | E2050 | 14.10.2022 | 14.10.2023 |
| Loop antenna | --- | --- | --- | --- | --- |

### 4.2.4 Detailed measurement data




Messung 125 kHz Cont. Mode 99 %

Measurement 9: 99% Bandwidth (Continuous mode)



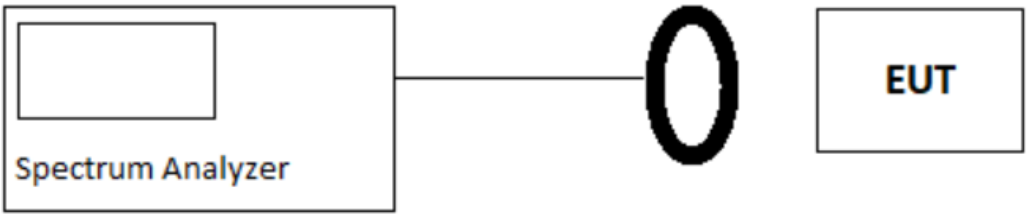

Messung 125 kHz Cyclic Mode 99 %

Measurement 10: 99% Bandwidth (Cyclic mode)

### 4.2.5 Measurement Procedure

The measurements were made in the operating mode, with the EUT producing the maximum emission, consistent with normal applications. The EUT load was adjusted within the range specified by manufacturer in order to maximize the emission.

The EUT was setup in a shielded room to perform the occupied bandwidth measurements.
The reference level is the level of the highest amplitude signal observed from the transmitter at either the fundamental frequency or first-order-modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical.
The results recorded were measured with the modulation which produces the worst-case (widest) occupied bandwidth.




Test setup

# Annex A: Accreditation certificate (for information)

The accreditation relates to competences stated on the accreditation certificate. The current certificate is available on the homepage of the DAkkS and can be downloaded under accredited bodies with the processing number:
**https://www.dakks.de/en**

# Annex B: Additional information provided by client

None.

****** End of test report *****