

TEST REPORT

Test report no.: 1-5071_22-01-06

BNetzA-CAB-02/21-102

Testing laboratory

CTC advanced GmbH

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Accredited Testing Laboratory:

The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2018-03) by the Deutsche Akkreditierungsstelle GmbH (DAkkS)
The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate starting with the registration number: D-PL-12076-01.

Applicant

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Manufacturer

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Test standard/s

FCC - Title 47 CFR Part 15 FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices
RSS - 247 Issue 2 Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence - Exempt Local Area Network (LE-LAN) Devices

For further applied test standards please refer to section 3 of this test report.

Test Item

Kind of test item: Display
Model name: ADC-T40-HQ
FCC ID: 2AC3T-B36T40HQRA
ISED certification number: 12323A-B36T40HQRA
Frequency band: 902 MHz – 928 MHz
Technology tested: Zwave
Antenna: Integrated antenna
Power supply: 4.5 V to 5.5 V DC by external power supply
Temperature range: +5°C to +35°C

This test report is electronically signed and valid without handwritten signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

Test report authorized:

Christoph Schneider
Lab Manager
Radio Communications

Test performed:

Tobias Wittenmeier
Testing Manager
Radio Communications

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2 General information

2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. CTC advanced GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.

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This test report is electronically signed and valid without handwritten signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

2.2 Application details

| | |
|------------------------------------|------------|
| Date of receipt of order: | 2022-12-07 |
| Date of receipt of test item: | 2023-01-06 |
| Start of test:* | 2023-01-16 |
| End of test:* | 2023-01-18 |
| Person(s) present during the test: | -/- |

*Date of each measurement, if not shown in the plot, can be requested. Dates are stored in the measurement software.





2.3 Test laboratories sub-contracted

None

3 Test standard/s, references and accreditations

| Test standard | Date | Description |
|---|---------------|--|
| FCC - Title 47 CFR Part 15 | | FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices |
| RSS - 247 Issue 2 | February 2017 | Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence - Exempt Local Area Network (LE-LAN) Devices |
| RSS - Gen Issue 5 incl. Amendment 1 & 2 | February 2021 | Spectrum Management and Telecommunications Radio Standards Specification - General Requirements for Compliance of Radio Apparatus |

| Guidance | Version | Description |
|------------------|---------|---|
| ANSI C63.4-2014 | -/- | American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz |
| ANSI C63.10-2013 | -/- | American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices |

| Accreditation | Description | |
|------------------|---|---|
| D-PL-12076-01-04 | Telecommunication and EMC Canada https://www.dakks.de/as/ast/d/D-PL-12076-01-04e.pdf |   |
| D-PL-12076-01-05 | Telecommunication FCC requirements https://www.dakks.de/as/ast/d/D-PL-12076-01-05e.pdf |   |

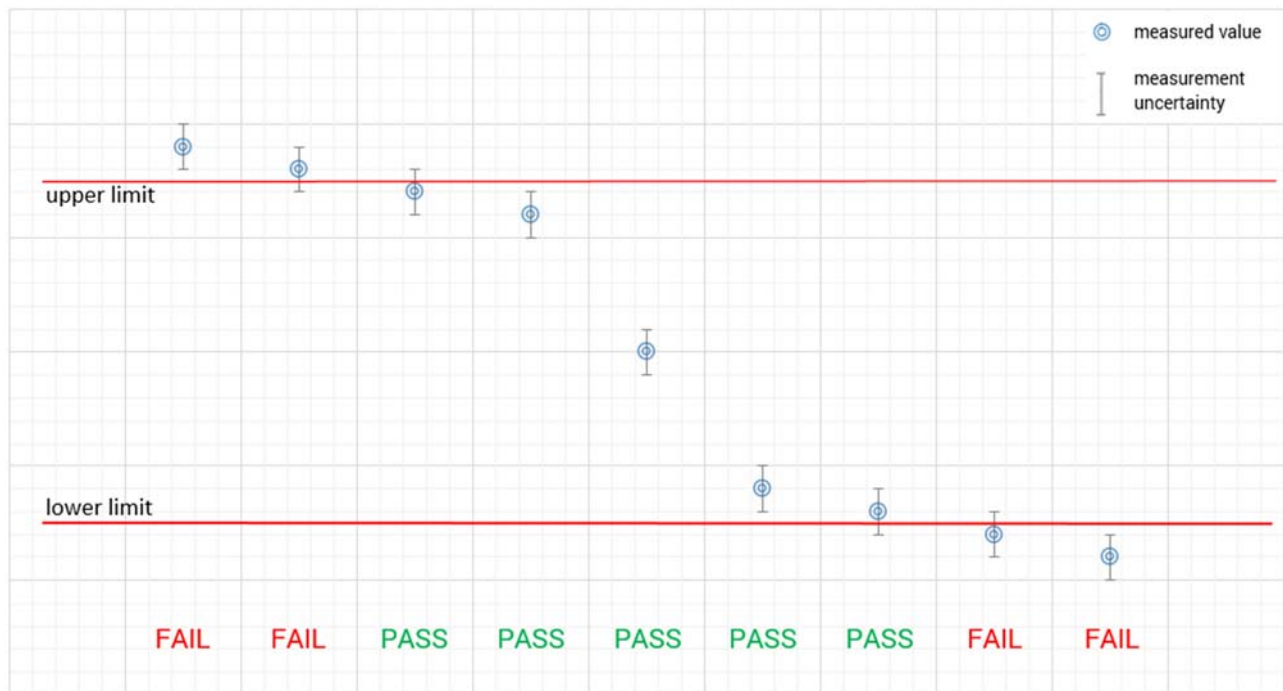
ISED Testing Laboratory Recognized Listing Number: DE0001
FCC designation number: DE0002

4 Reporting statements of conformity – decision rule

Only the measured values related to their corresponding limits will be used to decide whether the equipment under test meets the requirements of the test standards listed in chapter 3.

The measurement uncertainty is mentioned in this test report, see chapter 9, but is not taken into account - neither to the limits nor to the measurement results. Measurement results with a smaller margin to the corresponding limits than the measurement uncertainty have a potential risk of more than 5% that the decision might be wrong."

measured value, measurement uncertainty, verdict



5 Test environment

| | | | |
|---------------------------|---|--|--|
| Temperature | : | T _{nom} T _{max} T _{min} | +22 °C during room temperature tests +35 °C during high temperature tests* +5 °C during low temperature tests* |
| Relative humidity content | : | | 55 % |
| Barometric pressure | : | | 1021 hpa |
| Power supply | : | V _{nom} V _{max} V _{min} | 5.0 V DC by external power supply 5.5 V* 4.5 V* |

*No tests under extreme conditions required.

6 Test item

6.1 General description

| | | |
|----------------------------|---|--|
| Kind of test item | : | Display |
| Model name | : | ADC-T40-HQ |
| HMN | : | -/- |
| PMN | : | ADC-T40-HQ-AT; ADC-T40-HQ-VZ; ADC-T40-HQ-VZ; ADC-T40-HQ-VZ-W |
| HVIN | : | B36-T40-HQ-Z-A |
| FVIN | : | -/- |
| S/N serial number | : | 015770000326877 |
| Hardware status | : | ADC-T40-HQ LTE |
| Software status | : | v1.0 |
| Firmware status | : | -/- |
| Frequency band | : | 902 MHz – 928 MHz |
| Type of radio transmission | : | DSSS |
| Use of frequency spectrum | : | |
| Type of modulation | : | OQPSK |
| Number of channels | : | 2 |
| Antenna | : | Integrated antenna |
| Power supply | : | 4.5 V to 5.5 V DC by external power supply |
| Temperature range | : | +5°C to +35°C |

6.2 Additional information

The content of the following annexes is defined in the QA. It may be that not all of the listed annexes are necessary for this report, thus some values in between may be missing.

Test setup and EUT photos are included in test report:

1-5071_22-01-06_AnnexA
1-5071_22-01-06_AnnexB
1-5071_22-01-06_AnnexD

7 Description of the test setup

Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements with other calibrated test systems or effective verifications. Weekly chamber inspections and range calibrations are performed. Where possible, RF generating and signaling equipment as well as measuring receivers and analyzers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

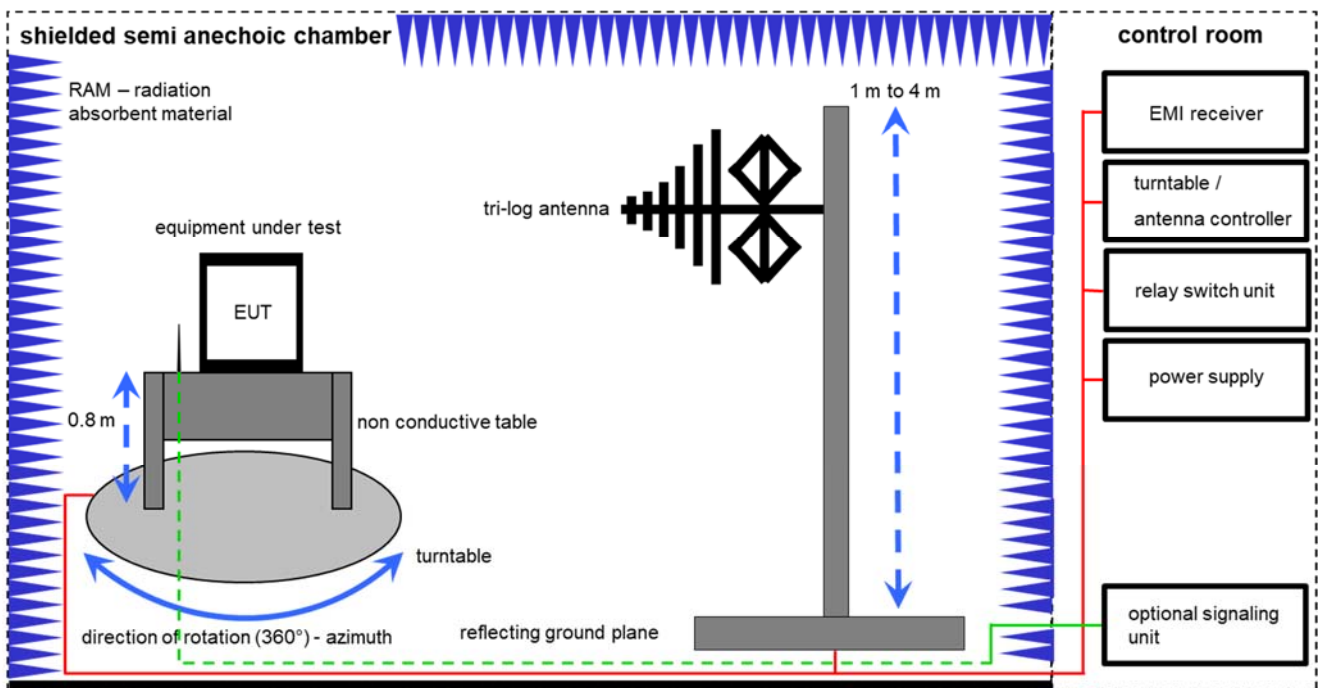
Each block diagram listed can contain several test setup configurations. All devices belonging to a test setup are identified with the same letter syntax. For example: Column Setup and all devices with an A.

Agenda: Kind of Calibration

| | | | |
|------|--|-----|--|
| k | calibration / calibrated | EK | limited calibration |
| ne | not required (k, ev, izw, zw not required) | zw | cyclical maintenance (external cyclical maintenance) |
| ev | periodic self verification | izw | internal cyclical maintenance |
| Ve | long-term stability recognized | g | blocked for accredited testing |
| v/k! | Attention: extended calibration interval | | |
| NK! | Attention: not calibrated | *) | next calibration ordered / currently in progress |

7.1 Shielded semi anechoic chamber

The radiated measurements are performed in vertical and horizontal plane in the frequency range from 30 MHz to 1 GHz in semi-anechoic chambers. The EUT is positioned on a non-conductive support with a height of 0.80 m above a conductive ground plane that covers the whole chamber. The receiving antennas are conform to specifications ANSI C63. These antennas can be moved over the height range between 1.0 m and 4.0 m in order to search for maximum field strength emitted from EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received. The wanted and unwanted emissions are received by spectrum analyzers where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.



Measurement distance: tri-log antenna 10 meter
EMC32 software version: 10.59.00

$FS = UR + CL + AF$
(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

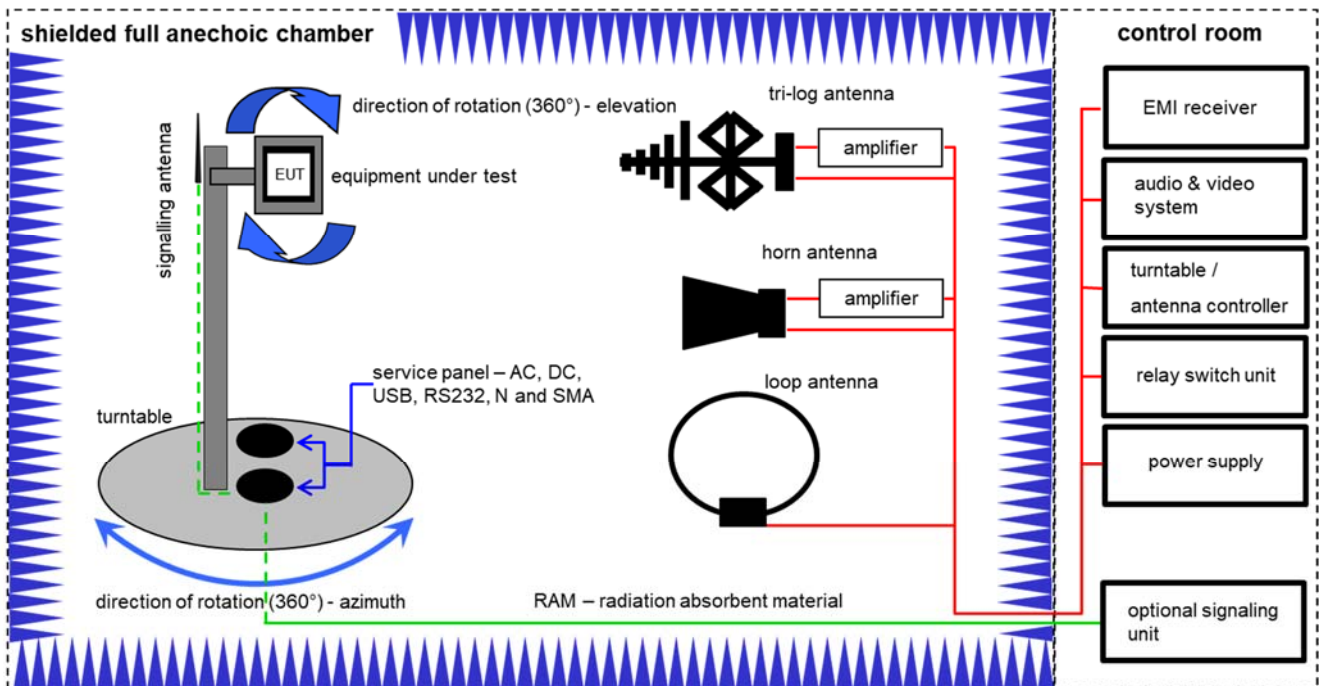
Example calculation:

$FS [dB\mu V/m] = 12.35 [dB\mu V/m] + 1.90 [dB] + 16.80 [dB/m] = 31.05 [dB\mu V/m] (35.69 \mu V/m)$

Equipment table:

| No. | Setup | Equipment | Type | Manufacturer | Serial No. | INV. No. | Kind of Calibration | Last Calibration | Next Calibration |
|-----|-------|---|--------------|-------------------------------|-----------------|-----------|---------------------|------------------|------------------|
| 1 | A | Switch-Unit | 3488A | HP | 2719A14505 | 300000368 | ev | -/- | -/- |
| 2 | A | Semi anechoic chamber | 3000023 | MWB AG | | 300000551 | ne | -/- | -/- |
| 3 | A | Analyzer-Reference-System (Harmonics and Flicker) | ARS 16/1 | SPS | A3509 07/0 0205 | 300003314 | vKI! | 29.12.2021 | 31.12.2023 |
| 4 | A | Antenna Tower | Model 2175 | ETS-Lindgren | 64762 | 300003745 | izw | -/- | -/- |
| 5 | A | Positioning Controller | Model 2090 | ETS-Lindgren | 64672 | 300003746 | izw | -/- | -/- |
| 6 | A | Turntable Interface-Box | Model 105637 | ETS-Lindgren | 44583 | 300003747 | izw | -/- | -/- |
| 7 | A | TRILOG Broadband Test-Antenna 30 MHz - 3 GHz | VULB9163 | Schwarzbeck Mess - Elektronik | 318 | 300003696 | vKI! | 30.09.2021 | 29.09.2023 |
| 8 | A | Spectrum-Analyzer | FSU26 | R&S | 200809 | 300003874 | k | 09.12.2022 | 31.12.2023 |
| 9 | A | Turntable | 2089-4.0 | EMCO | | 300004394 | ne | -/- | -/- |
| 10 | A | PC | TecLine | F+W | | 300004388 | ne | -/- | -/- |
| 11 | A | EMI Test Receiver | ESR3 | Rohde & Schwarz | 102587 | 300005771 | k | 09.12.2022 | 31.12.2023 |

7.2 Shielded fully anechoic chamber



Measurement distance: tri-log antenna and horn antenna 3 meter; loop antenna 3 meter / 1 meter

$$FS = UR + CA + AF$$

(FS-field strength; UR-voltage at the receiver; CA-loss of the signal path; AF-antenna factor)

Example calculation:

$$FS [dB\mu V/m] = 40.0 [dB\mu V/m] + (-35.8) [dB] + 32.9 [dB/m] = 37.1 [dB\mu V/m] (71.61 \mu V/m)$$

$$OP = AV + D - G + CA$$

(OP-radiated output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain+amplifier gain; CA-loss signal path)

Example calculation:

$$OP [dBm] = -65.0 [dBm] + 50 [dB] - 20 [dBi] + 5 [dB] = -30 [dBm] (1 \mu W)$$

Equipment table:

| No. | Setup | Equipment | Type | Manufacturer | Serial No. | INV. No. | Kind of Calibration | Last Calibration | Next Calibration |
|-----|-------|--|---|----------------------------------|--------------------|-----------|---------------------|------------------|------------------|
| 1 | A | Active Loop Antenna 9 kHz to 30 MHz | 6502 | EMCO | 2210 | 300001015 | vKI! | 01.07.2021 | 31.07.2023 |
| 2 | C | Double-Ridged Waveguide Horn Antenna 1-18.0GHz | 3115 | EMCO | 9107-3696 | 300001604 | vKI! | 12.03.2021 | 11.03.2023 |
| 3 | C | Highpass Filter | WHK1.1/15G-10SS | Wainwright | 37 | 400000148 | ne | -/- | -/- |
| 4 | C | Highpass Filter | WHKX7.0/18G-8SS | Wainwright | 18 | 300003789 | ne | -/- | -/- |
| 5 | B | TRILOG Broadband Test-Antenna 30 MHz - 3 GHz | VULB9163 | Schwarzbeck Mess - Elektronik | 295 | 300003787 | vKI! | 12.04.2021 | 30.04.2023 |
| 6 | A,B,C | 4U RF Switch Platform | L4491A | Agilent Technologies | MY50000032 | 300004510 | ne | -/- | -/- |
| 7 | A,B,C | Computer | Intel Core i3 3220/3,3 GHz, Prozessor | | 2V2403033A54 21 | 300004591 | ne | -/- | -/- |
| 8 | A,B,C | NEXIO EMV- Software | BAT EMC V2022.0.22.0 | Nexio | | 300004682 | ne | -/- | -/- |
| 9 | A,B,C | Anechoic chamber | | TDK | | 300003726 | ne | -/- | -/- |
| 10 | A,B,C | EMI Test Receiver 9kHz-26,5GHz | ESR26 | Rohde & Schwarz | 101376 | 300005063 | k | 13.12.2022 | 31.12.2023 |
| 11 | C | RF-Amplifier | AMF-6F06001800- 30-10P-R | NARDA-MITEQ Inc | 2011571 | 300005240 | ev | -/- | -/- |

8 Sequence of testing

8.1 Sequence of testing radiated spurious 9 kHz to 30 MHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, it is placed on a table with 0.8 m height.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement*

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna height is 1 m.
- At each turntable position the analyzer sweeps with positive-peak detector to find the maximum of all emissions.

Final measurement

- Identified emissions during the pre-measurement are maximized by the software by rotating the turntable from 0° to 360°.
- Loop antenna is rotated about its vertical axis for maximum response at each azimuth about the EUT. (For certain applications, the loop antenna plane may also need to be positioned horizontally at the specified distance from the EUT)
- The final measurement is done in the position (turntable and elevation) causing the highest emissions with quasi-peak (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. A plot with the graph of the premeasurement and the limit is stored.

*)Note: The sequence will be repeated three times with different EUT orientations.

8.2 Sequence of testing radiated spurious 30 MHz to 1 GHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 10 m or 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1 m to 3 m.
- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximize the peaks by changing turntable position $\pm 45^\circ$ and antenna height between 1 and 4 m.
- The final measurement is done with quasi-peak detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

8.3 Sequence of testing radiated spurious 1 GHz to 12.75 GHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a 2-axis positioner with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height is 1.5 m.
- At each turntable position and antenna polarization the analyzer sweeps with positive peak detector to find the maximum of all emissions.

Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximizes the peaks by rotating the turntable from 0° to 360°. This measurement is repeated for different EUT-table positions (0° to 150° in 30°-steps) and for both antenna polarizations.
- The final measurement is done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

9 Measurement uncertainty

| Measurement uncertainty | |
|---|--|
| Test case | Uncertainty |
| Antenna gain | ± 3 dB |
| Carrier frequency separation | ± 21.5 kHz |
| Number of hopping channels | -/- |
| Spectrum bandwidth | ± 21.5 kHz absolute; ± 15.0 kHz relative |
| Maximum output power | ± 1 dB |
| Detailed conducted spurious emissions @ the band edge | ± 1 dB |
| Band edge compliance radiated | ± 3 dB |
| Spurious emissions conducted | ± 3 dB |
| Spurious emissions radiated below 30 MHz | ± 3 dB |
| Spurious emissions radiated 30 MHz to 1 GHz | ± 3 dB |
| Spurious emissions radiated 1 GHz to 12.75 GHz | ± 3.7 dB |
| Spurious emissions radiated above 12.75 GHz | ± 4.5 dB |

10 Summary of measurement results

| | |
|-------------------------------------|---|
| <input type="checkbox"/> | No deviations from the technical specifications were ascertained |
| <input type="checkbox"/> | There were deviations from the technical specifications ascertained |
| <input checked="" type="checkbox"/> | This test report is only a partial test report. The content and verdict of the performed test cases are listed below. |

10.1 DSSS

| Test specification clause | Test case | Temperature conditions | Power source voltages | Mode | C | NC | NA | NP | Remark |
|---|--|------------------------|-----------------------|-------------------|-------------------------------------|--------------------------|--------------------------|-------------------------------------|---------------|
| §15.247(b)(4) RSS 210 / A8.4(2) | Antenna gain | Nominal | Nominal | TX single channel | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | -/- |
| §15.247(e) RSS - 247 / 5.2 (b) | Power spectral density | Nominal | Nominal | TX single channel | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | -/- |
| §15.247(a)(2) RSS Gen clause 4.6.1 | Spectrum bandwidth 6dB bandwidth | Nominal | Nominal | TX single channel | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | -/- |
| §15.247(b)(3) RSS - 247 / 5.4 (d) | Maximum output power | Nominal | Nominal | TX single channel | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | radiated only |
| §15.205 RSS - 247 / 5.5 RSS - Gen | Band edge compliance conducted | Nominal | Nominal | TX single channel | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | -/- |
| §15.205 RSS - 247 / 5.5 RSS - Gen | Band edge compliance radiated | Nominal | Nominal | -/- | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | -/- |
| §§15.247(d) RSS - 247 / 5.5 | TX spurious emissions conducted | Nominal | Nominal | TX single channel | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | -/- |
| §15.209(a) RSS-Gen | TX spurious emissions radiated < 30 MHz | Nominal | Nominal | TX single channel | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | -/- |
| §15.247(d) RSS-210 / A8.5 | TX spurious emissions radiated | Nominal | Nominal | TX single channel | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | -/- |
| §15.109 RSS-Gen. | RX spurious emissions radiated | Nominal | Nominal | RX | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | -/- |

11 RF measurements

11.1 Additional comments

Reference documents: None

Special test descriptions: None

Configuration descriptions: None

Test mode: Special software is used.
EUT is transmitting pseudo random data by itself

12 Measurement results Part 2 DSSS

12.1 Maximum output power

Measurement:

| Measurement parameter | |
|--------------------------|-------------------|
| Detector: | Peak |
| Sweep time: | Auto |
| Resolution bandwidth: | 1 MHz |
| Video bandwidth: | 3 MHz |
| Span: | 5 MHz |
| Trace-Mode: | Max Hold |
| Used equipment: | See chapter 7.2 B |
| Measurement uncertainty: | See chapter 9 |

Limits:

| FCC | IC |
|--|----|
| 1 watt (30 dBm) Maximum Output Power Conducted | |

Result:

| Test Conditions | | ERP / dBm | | |
|-----------------|-----------|-----------|-----|---------|
| | | 912 MHz | -/- | 920 MHz |
| T_{nom} | V_{nom} | 6.3 dBm | | 4.7 dBm |

12.2 Spurious Emissions Radiated < 30 MHz

Description:

Measurement of the radiated spurious emissions in transmit mode below 30 MHz. The measurement is performed in the mode with the highest output power. The limits are recalculated to a measurement distance of 3 m according to the ANSI C63.10.

Measurement:

| Measurement parameter | |
|--------------------------|--|
| Detector: | Peak / Quasi Peak |
| Sweep time: | Auto |
| Video bandwidth: | F < 150 kHz: 200 Hz F > 150 kHz: 9 kHz |
| Resolution bandwidth: | F < 150 kHz: 1 kHz F > 150 kHz: 100 kHz |
| Span: | 9 kHz to 30 MHz |
| Trace-Mode: | Max Hold |
| Used equipment: | See chapter 7.2 A |
| Measurement uncertainty: | See chapter 9 |

Limits:

| FCC | | |
|-----------------|---|--------------------------|
| Frequency (MHz) | Field strength ($\mu\text{V}/\text{m}$) | Measurement distance (m) |
| 0.009 – 0.490 | 2400/(F/kHz) | 300 |
| 0.490 – 1.705 | 24000/(F/kHz) | 30 |
| 1.705 – 30 | 30 (29.5 dB $\mu\text{V}/\text{m}$) | 30 |

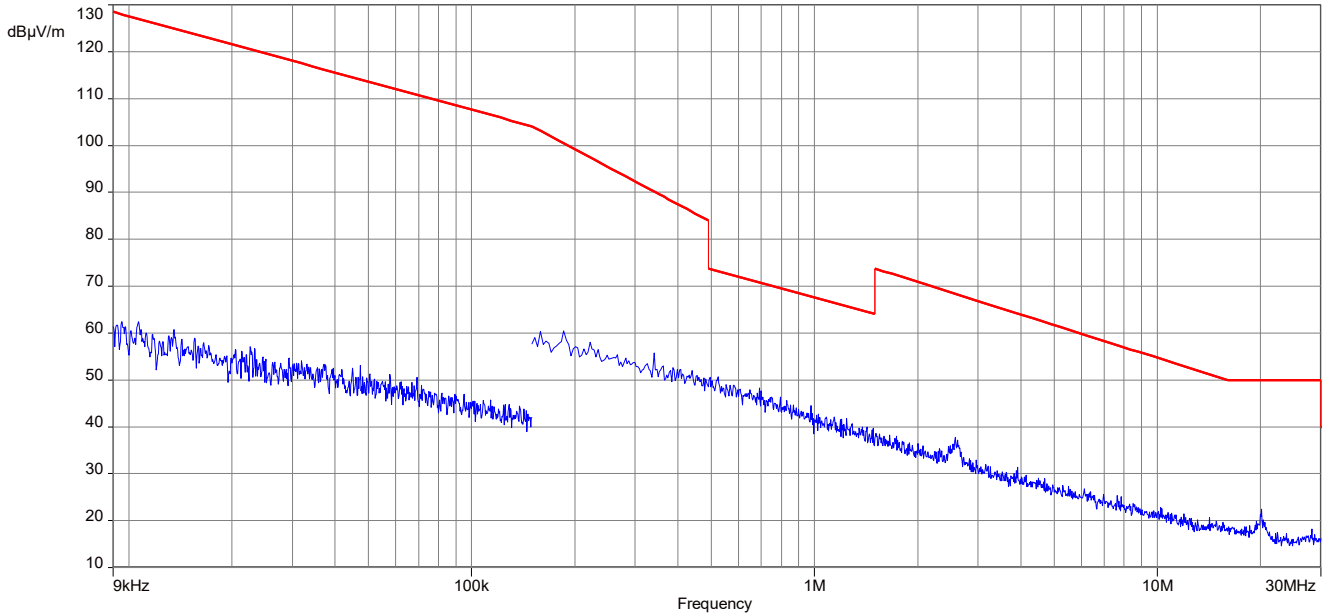
| IC | | |
|-----------------|---|--------------------------|
| Frequency (MHz) | Field strength (dB $\mu\text{A}/\text{m}$) | Measurement distance (m) |
| 0.009 – 0.490 | 2400/(F/kHz) | 300 |
| 0.490 – 1.705 | 24000/(F/kHz) | 30 |
| 1.705 – 30 | 0.08 (18.06 dB $\mu\text{A}/\text{m}$) | 30 |

Result:

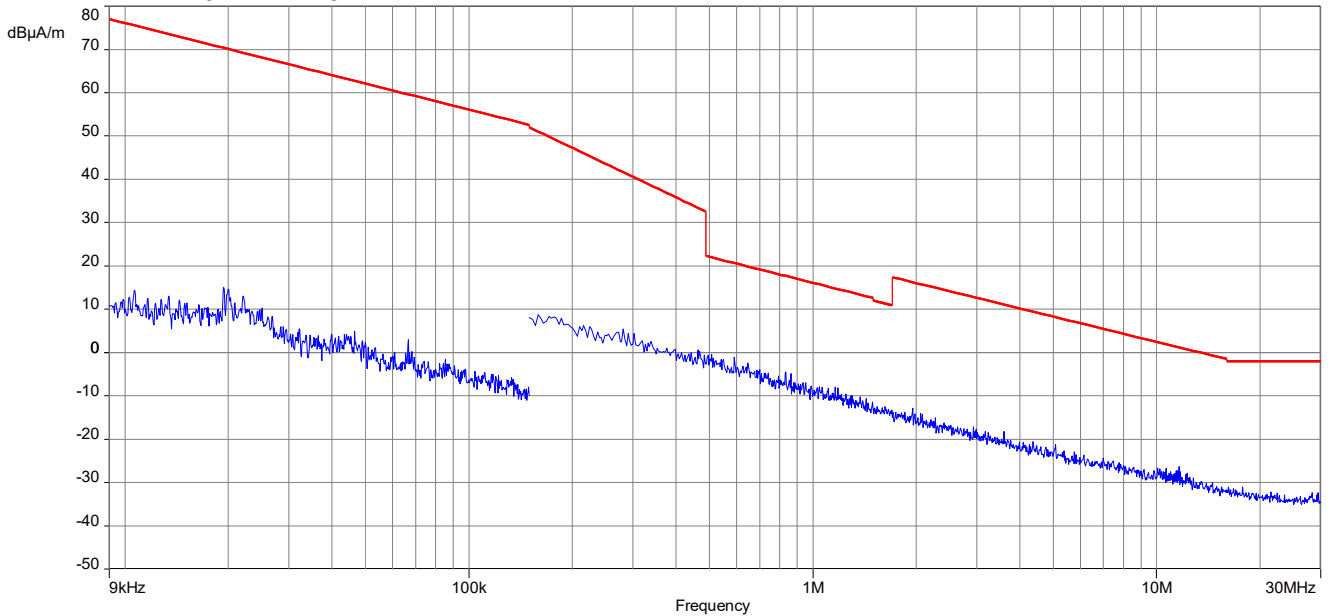
No emissions detected.

Plots:

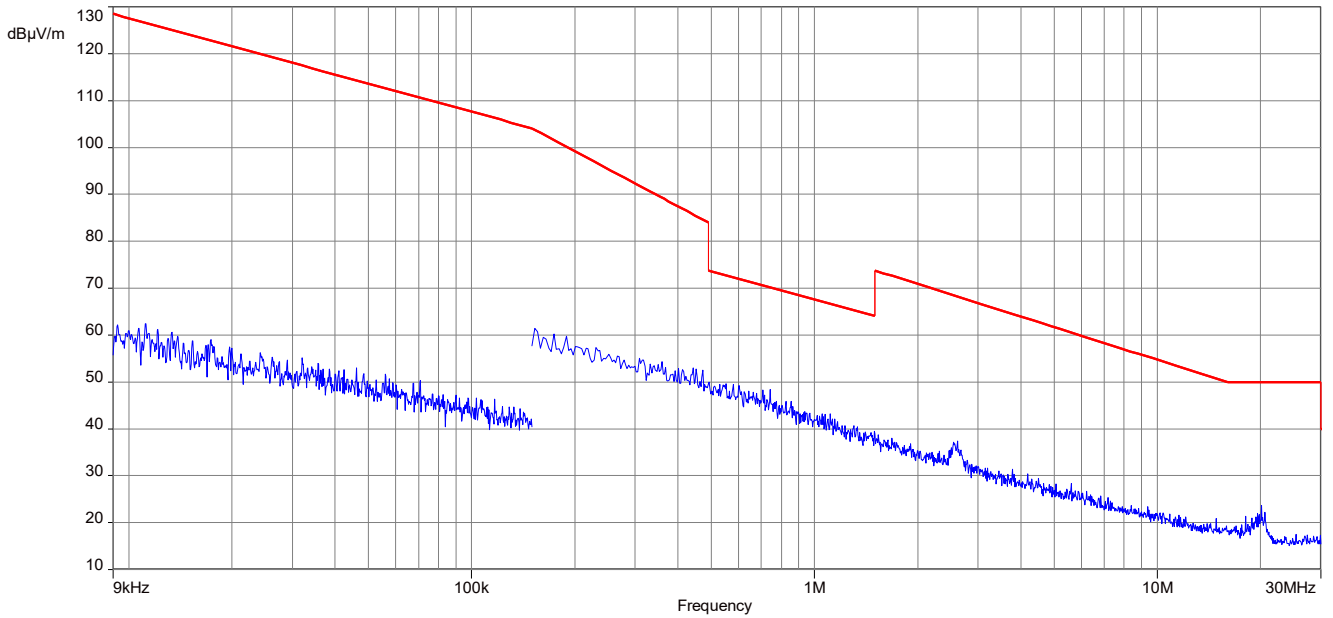
Plot 1: TX-Mode 912 MHz FCC



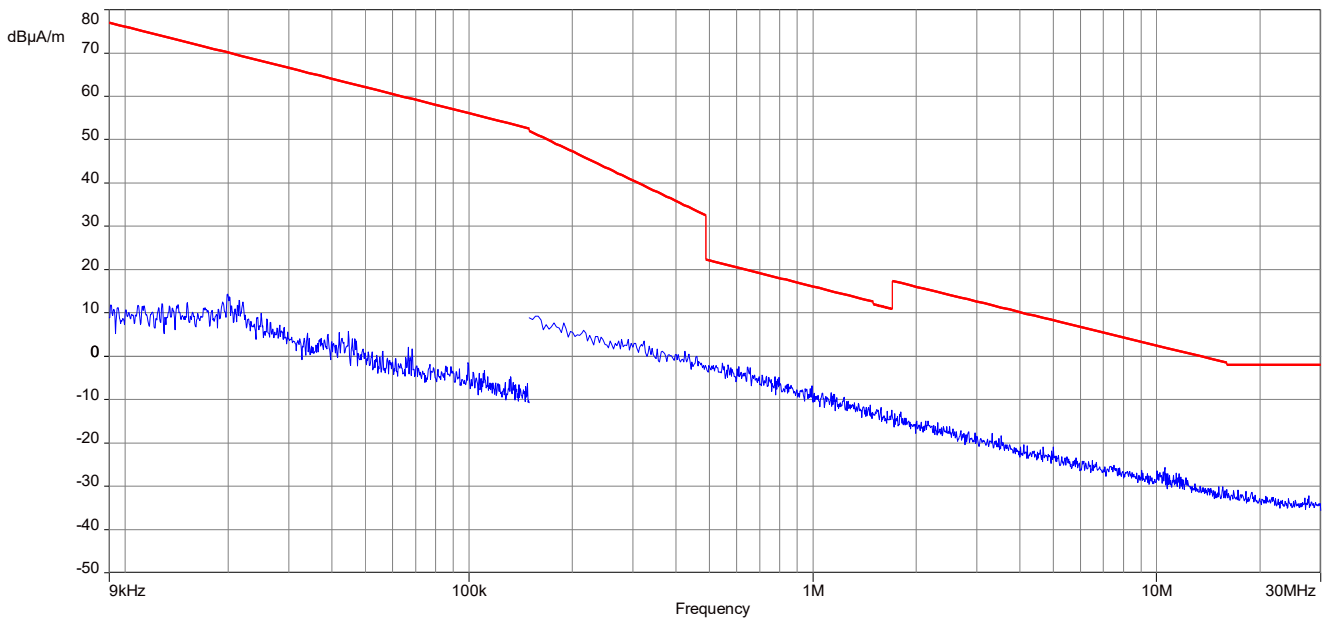
Plot 2: TX-Mode 912 MHz IC



Plot 3: TX-Mode 920 MHz FCC



Plot 4: TX-Mode 920 MHz IC



12.3 Spurious Emissions Radiated > 30 MHz

12.3.1 Spurious emissions radiated 30 MHz to 1 GHz

Description:

Measurement of the radiated spurious emissions in transmit mode. The measurement is performed at channel low, mid and high.

Measurement:

| Measurement parameters | |
|-------------------------|----------------------|
| Detector | Peak / Quasi Peak |
| Sweep time | Auto |
| Resolution bandwidth | 3 x VBW |
| Video bandwidth | 120 kHz |
| Span | 30 MHz to 1 GHz |
| Trace mode | Max hold |
| Measured modulation | DSSS |
| Test setup | See sub clause 7.1 A |
| Measurement uncertainty | See sub clause 9 |

Limits:

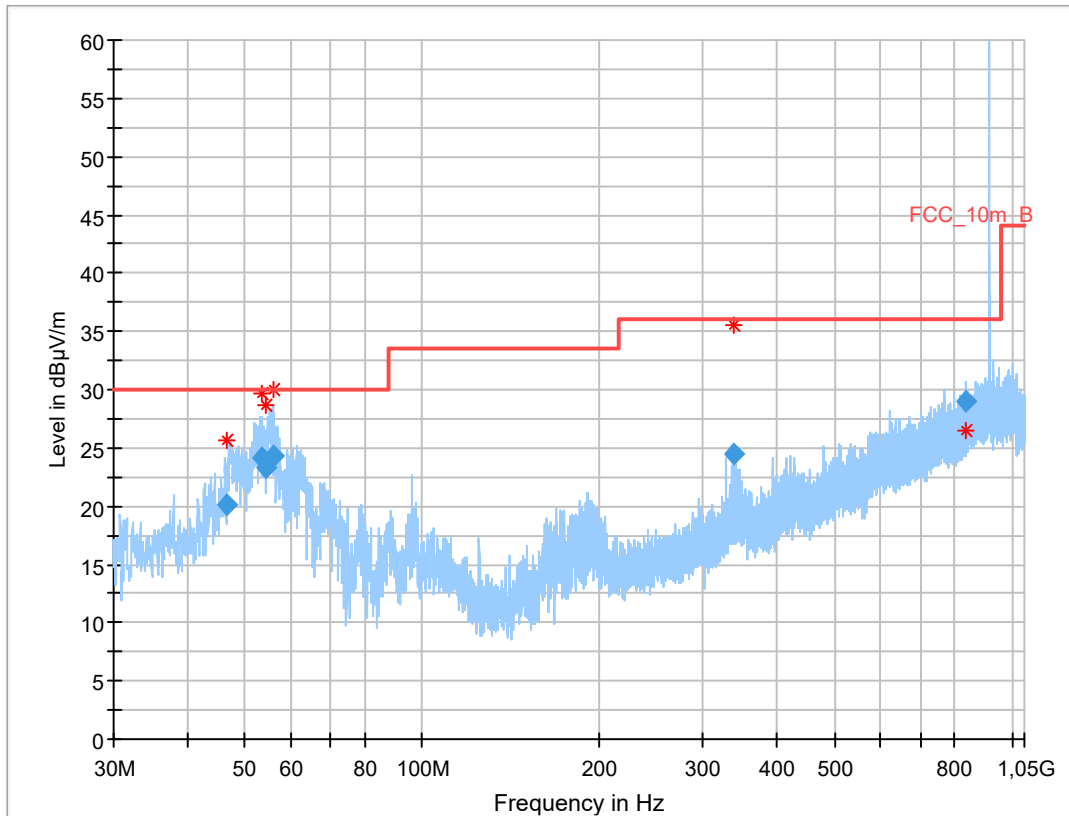
| FCC | IC | |
|---|---------------------------------|--------------------------|
| Band-edge Compliance of conducted and radiated emissions | | |
| <p>In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).</p> | | |
| Frequency / MHz | Field Strength / (dB μ V/m) | Measurement distance / m |
| 30 - 88 | 30.0 | 10 |
| 88 – 216 | 33.5 | 10 |
| 216 – 960 | 36.0 | 10 |
| Above 960 | 54.0 | 3 |

Result:

See result table below the plots.

Plots:

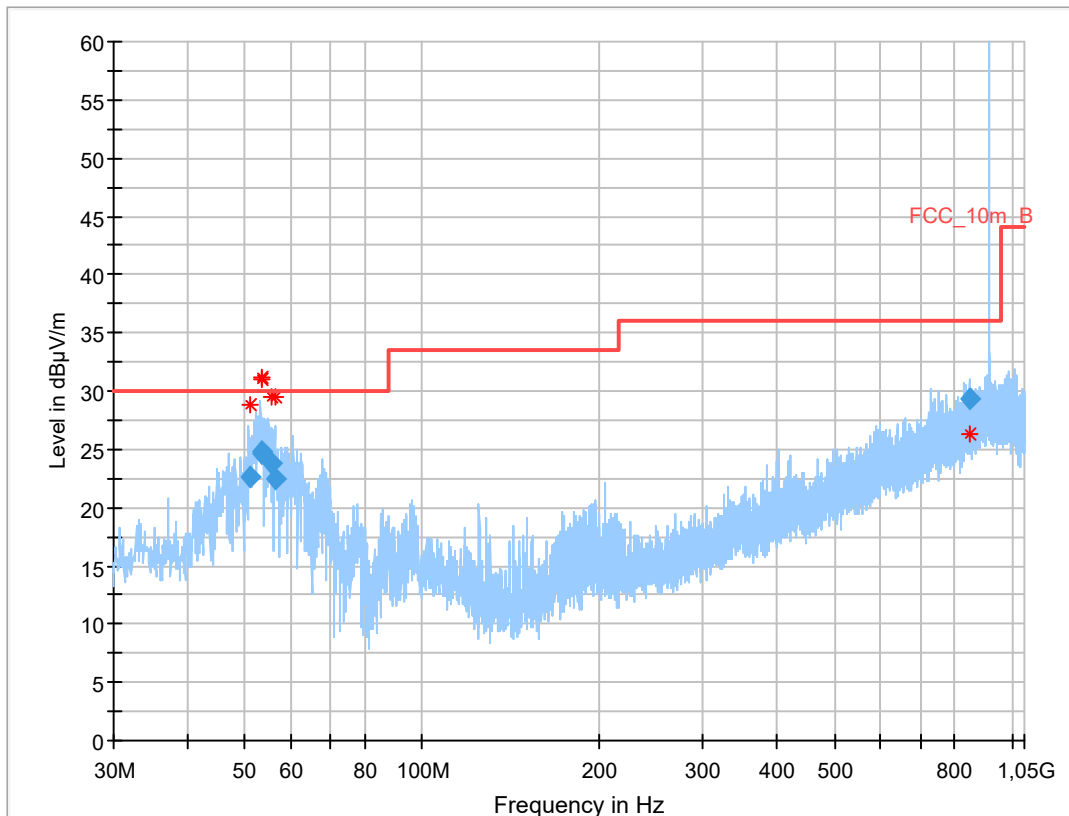
Plot 1: 30 MHz – 1 GHz, horizontal & vertical polarisation, 912 MHz



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) |
|-----------------|--------------------|----------------|-------------|-----------------|-----------------|-------------|-----|---------------|--------------|
| 46.607 | 20.11 | 30.0 | 9.9 | 1000 | 120.0 | 184.0 | V | 103 | 16 |
| 53.415 | 24.19 | 30.0 | 5.8 | 1000 | 120.0 | 195.0 | V | 307 | 15 |
| 54.482 | 23.25 | 30.0 | 6.8 | 1000 | 120.0 | 167.0 | V | 52 | 15 |
| 56.091 | 24.31 | 30.0 | 5.7 | 1000 | 120.0 | 149.0 | V | 104 | 16 |
| 337.388 | 24.50 | 36.0 | 11.5 | 1000 | 120.0 | 195.0 | H | 168 | 17 |
| 834.806 | 29.00 | 36.0 | 7.0 | 1000 | 120.0 | 110.0 | V | -37 | 24 |

Plot 2: 30 MHz – 1 GHz, horizontal & vertical polarisation, 920 MHz



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) |
|-----------------|--------------------|----------------|-------------|-----------------|-----------------|-------------|-----|---------------|--------------|
| 50.993 | 22.60 | 30.0 | 7.4 | 1000 | 120.0 | 104.0 | V | 282 | 15 |
| 53.528 | 24.78 | 30.0 | 5.2 | 1000 | 120.0 | 195.0 | V | 112 | 15 |
| 53.577 | 24.71 | 30.0 | 5.3 | 1000 | 120.0 | 100.0 | V | 15 | 15 |
| 55.656 | 23.83 | 30.0 | 6.2 | 1000 | 120.0 | 195.0 | V | 145 | 16 |
| 56.369 | 22.45 | 30.0 | 7.6 | 1000 | 120.0 | 152.0 | V | 157 | 16 |
| 847.932 | 29.38 | 36.0 | 6.6 | 1000 | 120.0 | 141.0 | H | 120 | 25 |

12.3.2 Spurious emissions radiated above 1 GHz

Description:

Measurement of the radiated spurious emissions in transmit mode. The measurement is performed in the mode with the highest output power.

Measurement:

| Measurement parameters | |
|-------------------------|--|
| Detector | Peak / RMS |
| Sweep time | Auto |
| Resolution bandwidth | 1 MHz |
| Video bandwidth | 3 x RBW |
| Span | 1 GHz to 12.75 GHz |
| Trace mode | Max hold |
| DSSS, FHSS Hybrid | DSSS |
| Test setup | See sub clause 7.2 C (1 GHz – 12.75 GHz) |
| Measurement uncertainty | See sub clause 9 |

The modulation with the highest output power was used to perform the transmitter spurious emissions. If spurious were detected a re-measurement was performed on the detected frequency with each modulation.

Limits:

| ANSI C63.10 |
|---|
| The average emission shall be determined by using Video averaging (VBW = 10 Hz). If the dwell time of the hopping signal is less than 100 ms (per channel), the VBW=10 Hz reading may be adjusted by a factor: $F = 20 \log(\text{dwell time}/100 \text{ ms})$ |

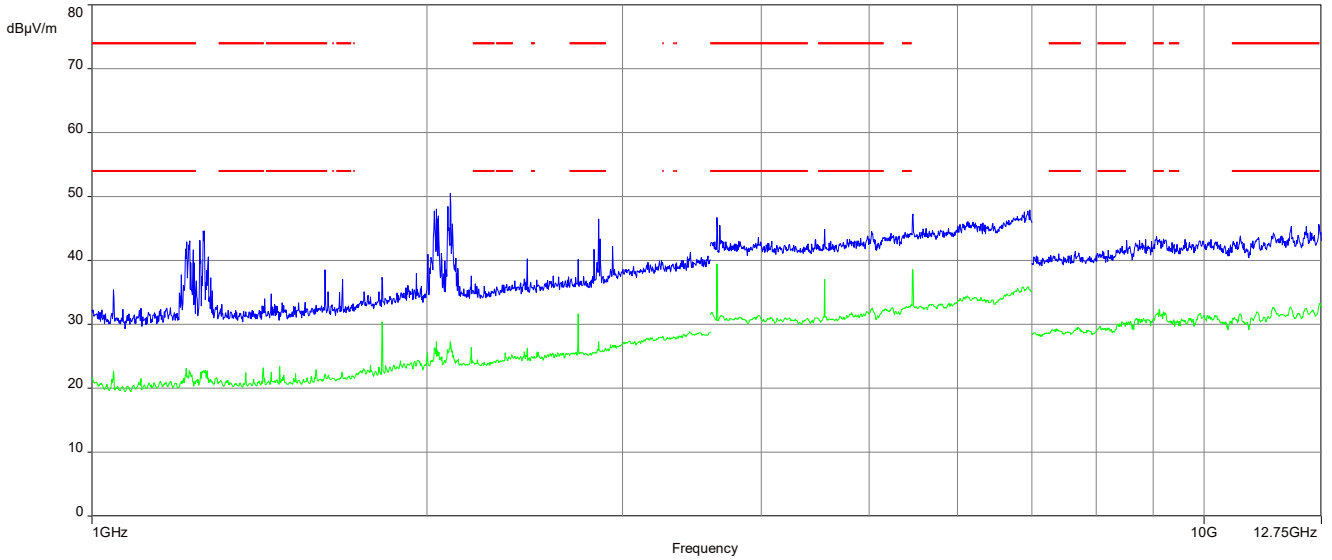
| FCC | IC | |
|--|---------------------------|--------------------------|
| TX spurious emissions radiated | | |
| In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)). | | |
| §15.209 | | |
| Frequency / MHz | Field strength / (dBµV/m) | Measurement distance / m |
| Above 960 | 54.0 | 3 |

Result:

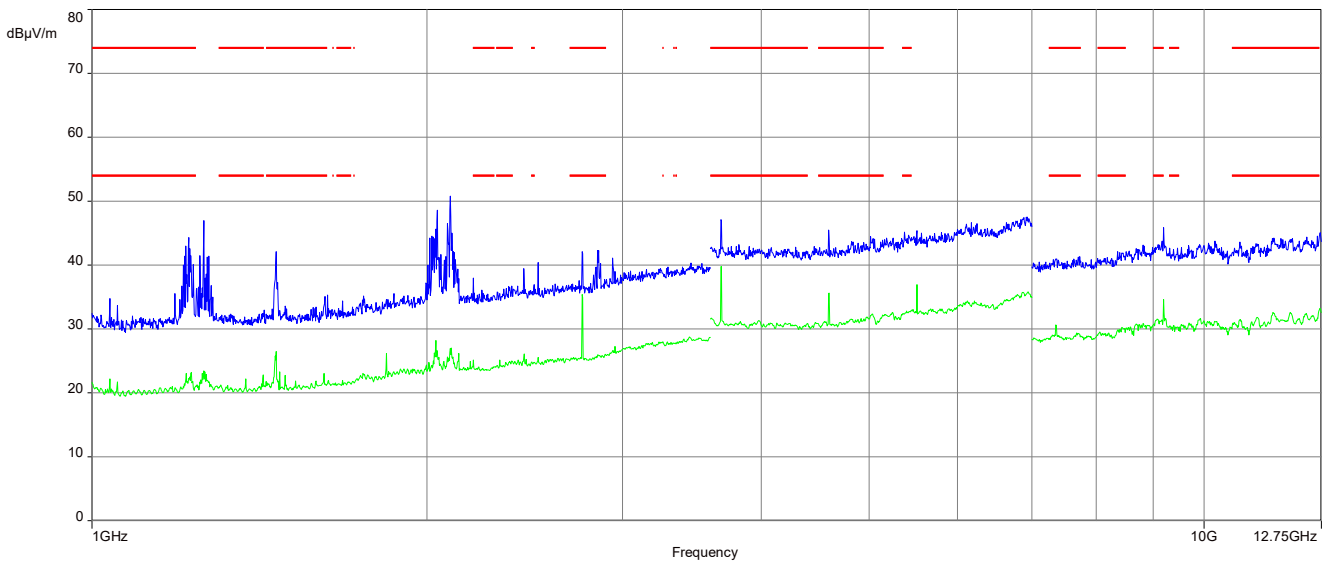
| TX spurious emissions radiated | | | | | | | | |
|---|----------|------------------------|-----------------|----------|------------------------|---|----------|------------------------|
| 912 MHz | | | -/- | | | 920 MHz | | |
| Frequency / MHz | Detector | Level / (dB μ V/m) | Frequency / MHz | Detector | Level / (dB μ V/m) | Frequency / MHz | Detector | Level / (dB μ V/m) |
| All emissions were more than 10 dB below the limit. | | | | Peak | | All emissions were more than 10 dB below the limit. | | |
| | | | | AVG | | | | |

Plots:

Plot 1: 1 GHz – 12.75 GHz, horizontal & vertical polarisation (lowest channel)



Plot 2: 1 GHz – 12.75 GHz, horizontal & vertical polarisation (middle channel)



13 Observations

No observations except those reported with the single test cases have been made.

14 Glossary

| | |
|------------------------|--|
| EUT | Equipment under test |
| DUT | Device under test |
| UUT | Unit under test |
| GUE | GNSS User Equipment |
| ETSI | European Telecommunications Standards Institute |
| EN | European Standard |
| FCC | Federal Communications Commission |
| FCC ID | Company Identifier at FCC |
| IC | Industry Canada |
| PMN | Product marketing name |
| HMN | Host marketing name |
| HVIN | Hardware version identification number |
| FVIN | Firmware version identification number |
| EMC | Electromagnetic Compatibility |
| HW | Hardware |
| SW | Software |
| Inv. No. | Inventory number |
| S/N or SN | Serial number |
| C | Compliant |
| NC | Not compliant |
| NA | Not applicable |
| NP | Not performed |
| PP | Positive peak |
| QP | Quasi peak |
| AVG | Average |
| OC | Operating channel |
| OCW | Operating channel bandwidth |
| OBW | Occupied bandwidth |
| OOB | Out of band |
| DFS | Dynamic frequency selection |
| CAC | Channel availability check |
| OP | Occupancy period |
| NOP | Non occupancy period |
| DC | Duty cycle |
| PER | Packet error rate |
| CW | Clean wave |
| MC | Modulated carrier |
| WLAN | Wireless local area network |
| RLAN | Radio local area network |
| DSSS | Dynamic sequence spread spectrum |
| OFDM | Orthogonal frequency division multiplexing |
| FHSS | Frequency hopping spread spectrum |
| GNSS | Global Navigation Satellite System |
| C/N₀ | Carrier to noise-density ratio, expressed in dB-Hz |

15 Document history

| Version | Applied changes | Date of release |
|---------|-----------------|-----------------|
| -/- | Initial release | 2023-01-23 |

16 Accreditation Certificate – D-PL-12076-01-04

| first page | last page |
|--|--|
|  <p>The first page of the accreditation certificate includes the DAKKS logo, the name 'Deutsche Akkreditierungsstelle GmbH', and text stating it is entrusted according to Section 8 subsection 1 of the AkkStelleG. It lists the signatory as CTC advanced GmbH, located at Untertürkheimer Straße 6-10, 66117 Saarbrücken. The certificate is for Telecommunication (TC) and Electromagnetic Compatibility (EMC) for Canadian Standards. It is signed by Ingrid Egner, Head of Division, on 09.06.2020 in Frankfurt am Main. A registration number D-PL-12076-01-04 is provided.</p> |  <p>The last page of the certificate lists three offices: Berlin, Frankfurt am Main, and Braunschweig. It contains a disclaimer that extracts of the certificate require prior approval. It also states that the accreditation was granted pursuant to the Act on the Accreditation Body (AkkStelleG) of 31 July 2009. It lists the websites for EA, ILAC, and IAF.</p> |

Note: The current certificate annex is published on the websites (link see below).

<https://www.dakks.de/files/data/as/pdf/D-PL-12076-01-04e.pdf>

OR

https://ctcadvanced.com/app/uploads/2020/06/D-PL-12076-01-04_Canada_TCEMC.pdf

17 Accreditation Certificate – D-PL-12076-01-05

| first page | last page | | | |
|---|---|--|--|--|
|  <p>Deutsche Akkreditierungsstelle GmbH</p> <p>Entrusted according to Section 8 subsection 1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBV Signatory to the Multilateral Agreements of EA, ILAC and IAF for Mutual Recognition</p> <p>Accreditation </p> <p>The Deutsche Akkreditierungsstelle GmbH attests that the testing laboratory CTC advanced GmbH Untertürkheimer Straße 6-10, 66117 Saarbrücken is competent under the terms of DIN EN ISO/IEC 17025:2018 to carry out tests in the following fields: Telecommunication (FCC Requirements)</p> <p>The accreditation certificate shall only apply in connection with the notice of accreditation of 09.06.2020 with the accreditation number D-PL-12076-01. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 05 pages.</p> <p>Registration number of the certificate: D-PL-12076-01-05</p> <p>Frankfurt am Main, 09.06.2020  by Jörg Oehl-Ing. (FH) Head of Division</p> <p><small>The certificate together with its annex reflects the status at the time of the date of issue. The current status of the scope of accreditation can be found in the database of accredited bodies of Deutsche Akkreditierungsstelle GmbH. https://www.dakks.de/en/content/accredited-bodies-dakks See notes internal.</small></p> | <p>Deutsche Akkreditierungsstelle GmbH</p> <table border="0"> <tr> <td>Office Berlin Spittelmarkt 10 10117 Berlin</td> <td>Office Frankfurt am Main Europa-Allee 52 60327 Frankfurt am Main</td> <td>Office Braunschweig Bundesallee 100 38116 Braunschweig</td> </tr> </table> <p>The publication of extracts of the accreditation certificate is subject to the prior written approval by Deutsche Akkreditierungsstelle GmbH (DAkks). Exempted is the unchanged form of separate disseminations of the cover sheet by the conformity assessment body mentioned overleaf.</p> <p>No impression shall be made that the accreditation also extends to fields beyond the scope of accreditation attested by DAkks.</p> <p><small>The accreditation was granted pursuant to the Act on the Accreditation Body (AkkStelleG) of 31 July 2009 (Federal Law Gazette I p. 2625) and the Regulation (EC) No 765/2008 of the European Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products (Official Journal of the European Union L 218 of 9 July 2008, p. 30). DAkks is a signatory to the Multilateral Agreements for Mutual Recognition of the European co-operation for Accreditation (EA), International Accreditation Forum (IAF) and International Laboratory Accreditation Cooperation (ILAC). The signatories to these agreements recognise each other's accreditations.</small></p> <p><small>The up-to-date state of membership can be retrieved from the following websites: EA: www.european-accreditation.org ILAC: www.ilac.org IAF: www.iaf.nu</small></p> | Office Berlin Spittelmarkt 10 10117 Berlin | Office Frankfurt am Main Europa-Allee 52 60327 Frankfurt am Main | Office Braunschweig Bundesallee 100 38116 Braunschweig |
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END OF TEST REPORT