

Test report

Number **T251-0076/25 M1** **Project file:** C20231529
Date: 2025-07-23
Pages: 91

Product: **Vacuum cleaner**

Type reference: **CT MIDI I (US), CT MIDI I AC (US)**

Ratings: 120 V a.c.; 60 Hz; 1200 W
Class I

Trademark:



Applicant: **Festool GmbH**
Wertstrasse 20, 73240 Wendlingen, Germany

Manufacturer: Festool GmbH
Wertstrasse 20, 73240 Wendlingen, Germany

Place of manufacture: TTS Cleantec GmbH
Pionierstr. 1, 89257 Illertissen, Germany

Summary of testing

Testing method: 47 CFR Part 15, Subpart C (Clause 15.247)
RSS-Gen (Issue 5), RSS-247 (Issue 3)
in conjunction with ANSI C63.10:2013

Testing location: SIQ Ljubljana
Mašera-Spasičeva ulica 10, SI-1000 Ljubljana, Slovenia

Remarks: Date of receipt of test items: 2024-06-09
Number of items tested: 2
Date of performance of tests: 2024-08-19 – 2025-06-23
The test results presented in this report relate only to the items tested.
The test items were tested in the condition as received.
The product complies with the requirements of the testing methods.

Tested by: Luka Cvajnar



Approved by: Marjan Mak



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1 GENERAL

EUT passed the performed tests.

| History sheet | | | |
|---------------|-----------------|---|----------|
| Date | Report No. | Change | Revision |
| 2025-07-09 | T251-0076/25 | Initial Test Report issued. | -- |
| 2025-07-23 | T251-0076/25 M1 | This test report substitutes previously issued test report T251-0076/25, dated 2025-07-09. Update of test report due to new hardware version(HVIN). No tests required for the update. | 1.0 |

1.1 Description of equipment under test

Vacuum cleaner

Type: CT MIDI I (US), CT MIDI I AC (US)

FCC ID: 2AL2E-CTCOM2

IC: 22501-CTCOM2

| | |
|--|----------------------------|
| Adaptive / non-adaptive equipment | non-adaptive equipment |
| Modulation type | Other than FHSS |
| Operating mode | Single antenna |
| Operating temperature range | -20 °C to +80 °C |
| Maximum RF Output power | 4 dBm |
| Operating frequency | 2402 MHz – 2480 MHz |
| Number of channels | 40 |
| Antenna type and gain | Integral antenna, 1.68 dBi |
| Antenna Beamforming | / |
| Nominal channel bandwidth | 1 MHz and 2 MHz |
| Hardware version(HVIN): | 10664799 |
| Firmware version: | 10755580 |

Examples of marking plates

The artwork below may be only a draft. The use of certification marks on a product must be authorized by the respective NCBs that own these marks.



1.2 Description of the test modes

The equipment uses only one antenna at any moment.

On all devices run test firmware Bluetooth Direct Test Mode and accompanied by a USB-UART converter interface. For testing purposes sample with integral antenna and modified sample with added SMA connector was provided. For testing nRFgo Studio software program from Nordic Semiconductor was used.

1.2.1 Tested Channels

| Channels | Data rate | Frequency [MHz] | TX power Settings [dBm] | Packet type | Packet length (bytes) |
|--------------|-----------|-----------------|-------------------------|-------------|-----------------------|
| 0 (Lowest) | 1 Mbps | 2402 | 4 | PRBS9 | 37 |
| 19 (Middle) | 1 Mbps | 2440 | 4 | PRBS9 | 37 |
| 39 (Highest) | 1 Mbps | 2480 | 4 | PRBS9 | 37 |
| 0 (Lowest) | 2 Mbps | 2402 | 4 | PRBS9 | 37 |
| 19 (Middle) | 2 Mbps | 2440 | 4 | PRBS9 | 37 |
| 39 (Highest) | 2 Mbps | 2480 | 4 | PRBS9 | 37 |

Normal test condition:

Ambient temperature: 15 °C to 35 °C

Relative humidity: 30 % to 60 %

Atmospheric pressure: 860 mbar to 1060 mbar

1.3 Test Equipment used for testing

| Manufacturer | Model No. | Used | Calibrated | Calibrated until |
|---|--------------|------|------------|------------------|
| Comtest engineering, SAC2 (together with controlling equipment) | SAC 3m | X | 2022-04-14 | 2025-04-14 |
| Maturo, Turn table (2 m diameter) | TT 2.0 SI | X | / | / |
| Maturo, Bore-sight antenna mast | BAM-4.0-P | X | / | / |
| Maturo, positioning equipment | NCD | X | / | / |
| Rohde & Schwarz, RFI receiver | ESW 44 | X | 2023-03-09 | 2024-09-09 |
| R&S, Ultra Broadband Antenna | HL562E | X | 2023-09-26 | 2026-09-26 |
| R&S, Horn Antenna | HF907 | X | 2023-08-22 | 2026-08-22 |
| R&S, Spectrum Analyzer | FSV 40 | X | 2022-11-03 | 2024-11-03 |
| R&S, Vector signal generator | SMBV100B | / | / | / |
| R&S, Signal generator | SMB100A | / | 2022-11-07 | 2024-11-07 |
| R&S High resolution power meter | OSP-B157W8 | X | 2022-11-04 | 2024-11-04 |
| R&S Switch unit | OSP-B157WX | X | 2022-11-04 | 2024-11-04 |
| R&S, Artificial Mains network | ENV216 | X | 2022-06-21 | 2025-06-21 |
| Wainwright Instruments, High pass | WHNX6-2555- | X | 2024-05-30 | 2025-05-30 |
| Wainwright Instruments, High pass | WHNX6-5925- | / | / | / |
| Wainwright Instruments, High pass | WHW2-16340- | / | / | / |
| Hp, Manual step attenuator | 8494B 11 DB | / | / | / |
| Hp, Manual step attenuator | 8496B 110 DB | / | / | / |
| PMI Low noise amplifier | PEC-42-1G40G | X | 2023-09-18 | 2025-03-18 |
| KEYSIGHT, attenuator | 8491B 10 DB | / | / | / |
| Kambič, Temperature chamber | I-190 CK | / | / | / |

1.3.1 Measurement uncertainty

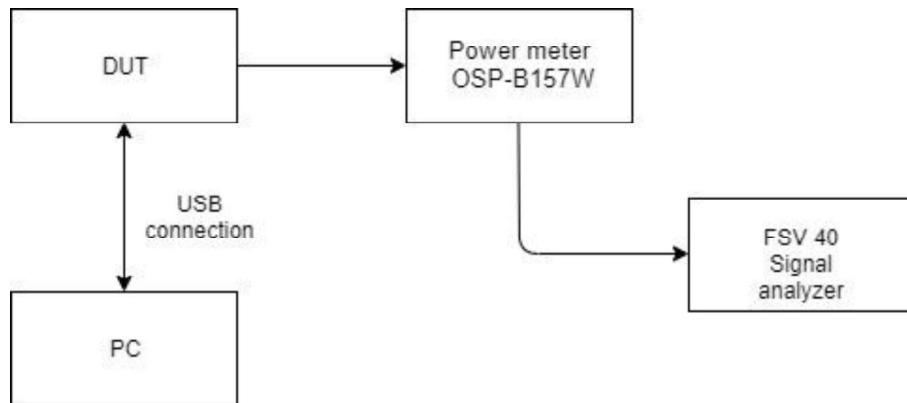
The following measurement uncertainty levels have been estimated for tests performed on the product, as specified in ETSI TR 100 028-2 and C63.23. This represents an expanded uncertainty expressed at 95% confidence level using a coverage factor k=2.

| Measurements | U_{LAB} | $U_{ETSI\ TR\ 100\ 028-2}$ | $U_{C63.23}$ |
|---|-----------|----------------------------|--------------|
| AC Line Conducted Emission | 3.2 dB | / | $\pm 4,13$ |
| Spurious emission 30 – 300 MHz | 4.2 dB | ± 6 | / |
| Spurious emission 300 – 1000 MHz | 4.4 dB | ± 6 | / |
| Spurious emission 1 GHz – 18 GHz | 5.1 dB | ± 6 | / |
| Spurious emission 18 GHz – 26GHz | 5.6 dB | ± 6 | / |
| Tx spurious emission - conducted | < 1.8 dB | ± 4 | / |
| 6 dB Emission Bandwidth | < 2% | $\pm 5\%$ | / |
| Maximum peak output power | < 1 dB | $\pm 0,75$ dB | / |
| 100 kHz Bandwidth of Frequency Band Edge | < 0.8 dB | / | / |
| Power Spectral Density | < 1.3 dB | ± 3 dB | / |
| Occupied bandwidth (99% emission bandwidth) | < 2% | $\pm 5\%$ | / |

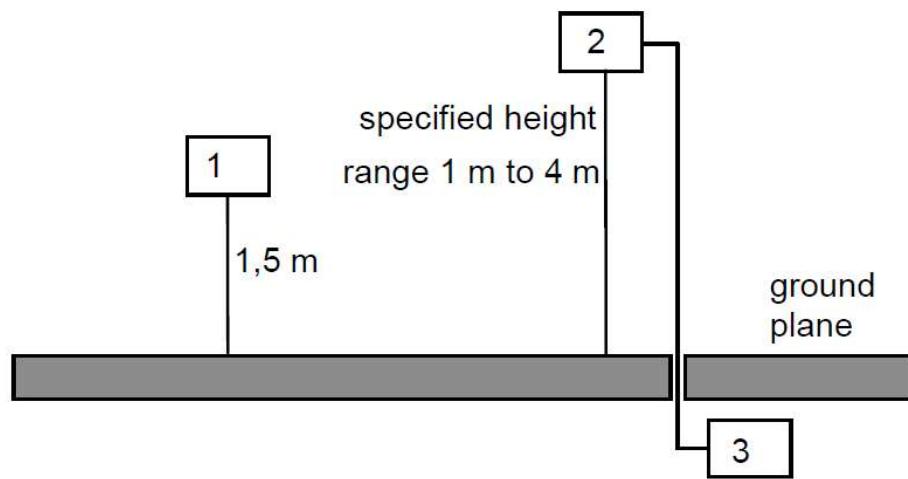
Note: Measurement uncertainty calculated in accordance with ETSI TR 100 028-2 and C63.23.

1.4 Test setup configurations

1.4.1 Conducted measurement test setup



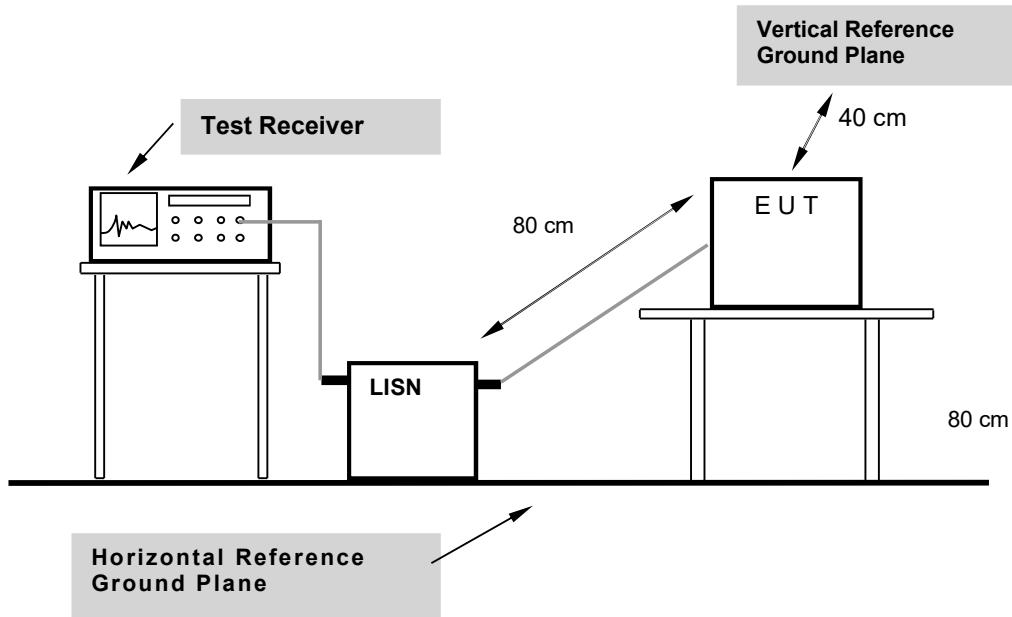
1.4.2 Radiated measurement test setup



- 1) UUT
- 2) Measurement antenna
- 3) Measurement equipment

Note: Below 1G non-conductive Table 80 cm above ground plane and above 1G non-conductive Table 150 cm above ground plane.

1.4.3 AC Line Conducted Emission



For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

2 TEST SUMMARY

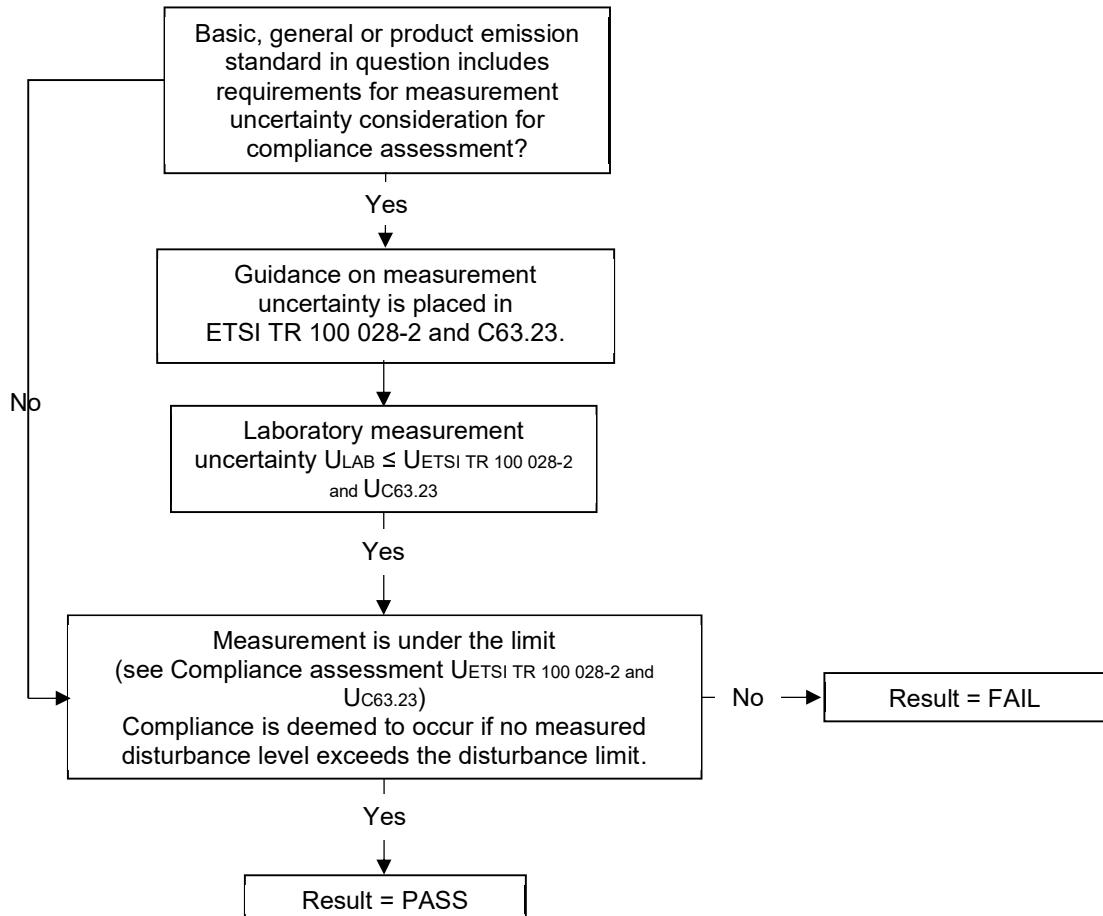
| 47 CFR 15.247 | | | |
|--|----------------------------------|---------------------------|------------|
| Test | 47 CFR section | Section within the report | Conclusion |
| Antenna Requirement | § 15.203 | 3.1 | PASS |
| AC Line Conducted Emission | § 15.207 (a) | 3.2 | PASS |
| Spurious emission - Conducted | § 15.247 (d) | 3.3 | PASS |
| Spurious emission - Radiated | § 15.205, § 15.209, § 15.247 (d) | 3.4 | PASS |
| 6 dB Emission Bandwidth | § 15.247 (a) (2) | 3.5 | PASS |
| Maximum peak output power | § 15.247 (b) (3) | 3.6 | PASS |
| 100 kHz Bandwidth of Frequency Band Edge | § 15.247 (d) | 3.7 | PASS |
| Power Spectral Density | § 15.247 (e) | 3.8 | PASS |

2.1 Application of decision rule

Application of decision rule and statement of conformity is defined in document TN023 Decision rule and measurement uncertainty.

As a general rule Pass/Fail decisions are based on simple acceptance rule and acceptance limits chosen based on simple acceptance ($w = 0$, $AL = TL$) except if a decision rule is governed by particular standard or guidance document.

Decision rule:



3 TESTS RESULTS

3.1 47 CFR § 15.203 – Antenna requirements

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

According § 15.247 (b), if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs § 15.247 (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

3.1.1 Antenna Details

| Type | Gain | Result |
|-------------|-----------|--------|
| PCB antenna | 1.68 dBi* | PASS |

*Measured. See test report T251-0357/25.

3.2 47 CFR § 15.207 – AC Line Conducted Emission

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

| Frequency of Emission (MHz) | Conducted Limit (dBuV) | |
|-----------------------------|------------------------|----------|
| | Quasi-Peak | Average |
| 0.15–0.5 | 66 to 56* | 56 to 46 |
| 0.5–5 | 56 | 46 |
| 5–30 | 60 | 50 |

*Decreases with the logarithm of the frequency.

3.2.1 Test procedure

EMI test receiver was set to investigate from 150 kHz to 30 MHz with the 9 kHz RBW. During conducted emission EUT was connected to a LISN and maximum emissions was recorded in the QP and average detection mode.

3.2.2 Test setup

For the test setup refer to chapter 1.4.

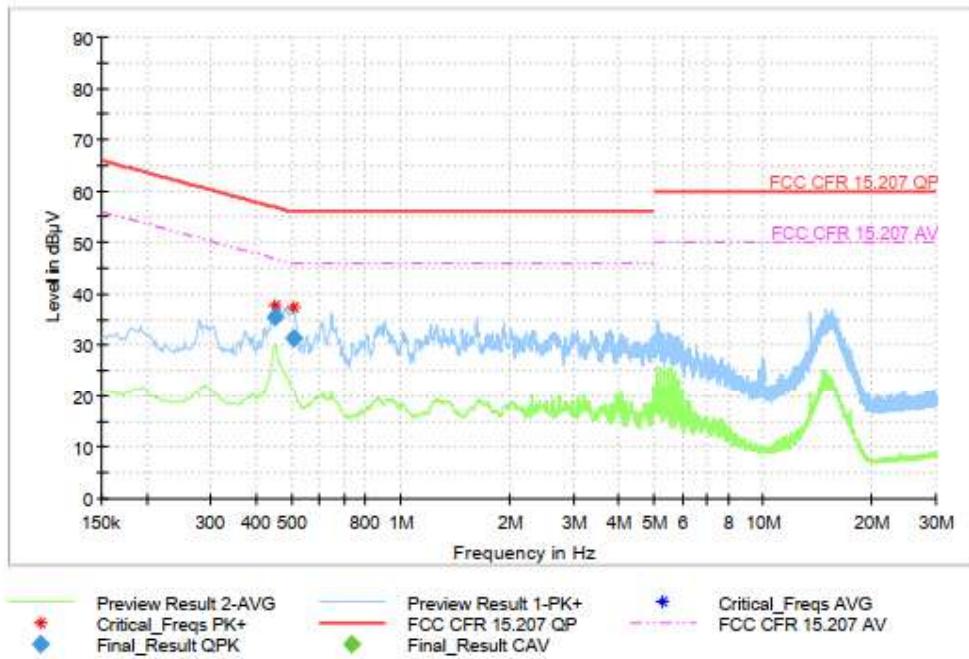
3.2.3 Test equipment

For the test equipment refer to chapter 1.3.

3.2.4 Test results

EUT Information

EUT: CT MIDI I AC
 Mode: Uin: 120 V, 60 Hz; TX BLE
 Line: L + N

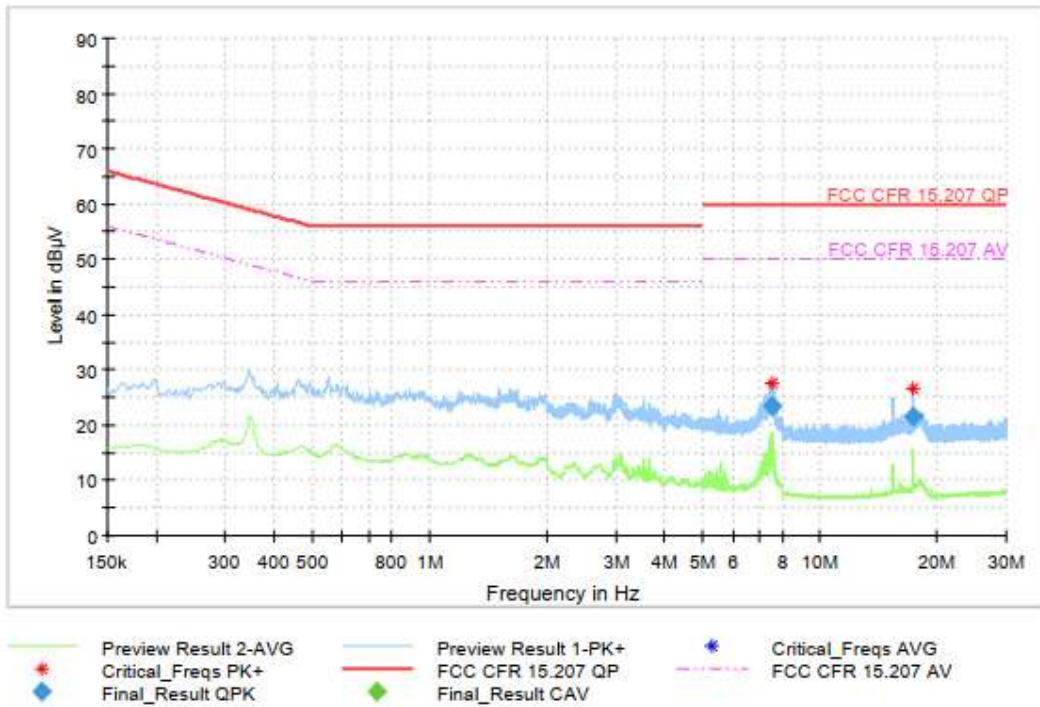


Final Result

| Frequency (MHz) | QuasiPeak (dB μ V) | CAverage (dB μ V) | Limit (dB μ V) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Line | Filter | Corr. (dB) |
|-----------------|------------------------|-----------------------|--------------------|-------------|-----------------|-----------------|------|--------|------------|
| 0.449250 | 35.41 | --- | 56.89 | 21.48 | 1000.0 | 9.000 | L1 | ON | 10.1 |
| 0.505500 | 31.29 | --- | 56.00 | 24.71 | 1000.0 | 9.000 | L1 | ON | 10.1 |

EUT Information

EUT: CT MIDI I
Operating mode: Uin: 120 V/ 60 Hz, BT Active
Line: L + N



Final Result

| Frequency (MHz) | QuasiPeak (dB μ V) | CAverage (dB μ V) | Limit (dB μ V) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Line | Filter | Corr. (dB) |
|-----------------|------------------------|-----------------------|--------------------|-------------|-----------------|-----------------|------|--------|------------|
| 7.518750 | 23.37 | — | 60.00 | 36.63 | 1000.0 | 9.000 | N | ON | 9.7 |
| 17.351250 | 21.62 | — | 60.00 | 38.38 | 1000.0 | 9.000 | L1 | ON | 9.9 |

3.3 47 CFR § 15.247(d) - Spurious emission - Conducted

§ 15.247 (d):

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)).

3.3.1 Test setup

For the test setup refer to chapter 1.4

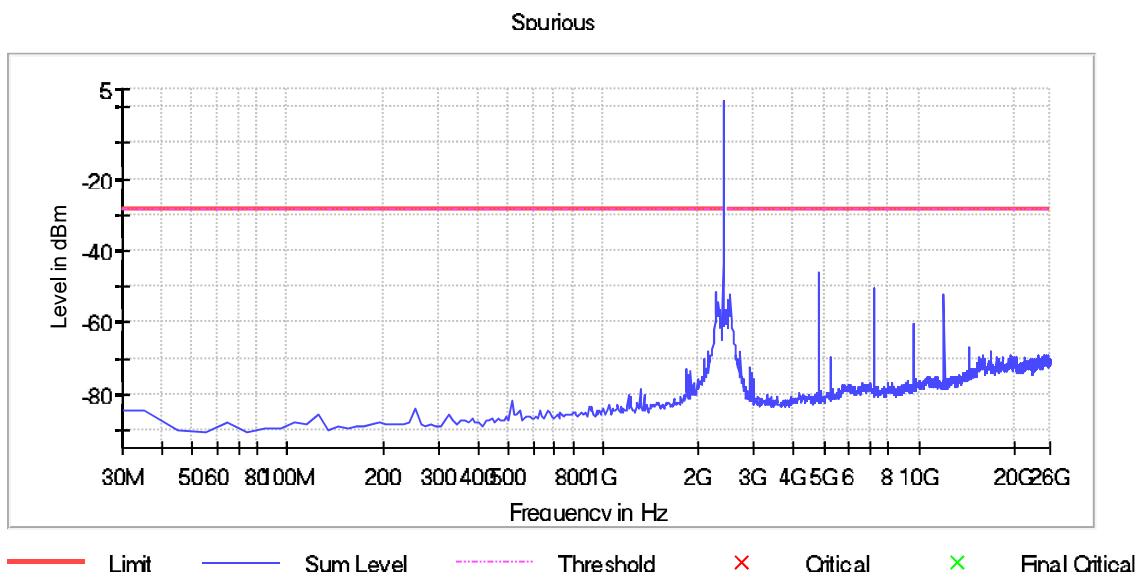
3.3.2 Test equipment

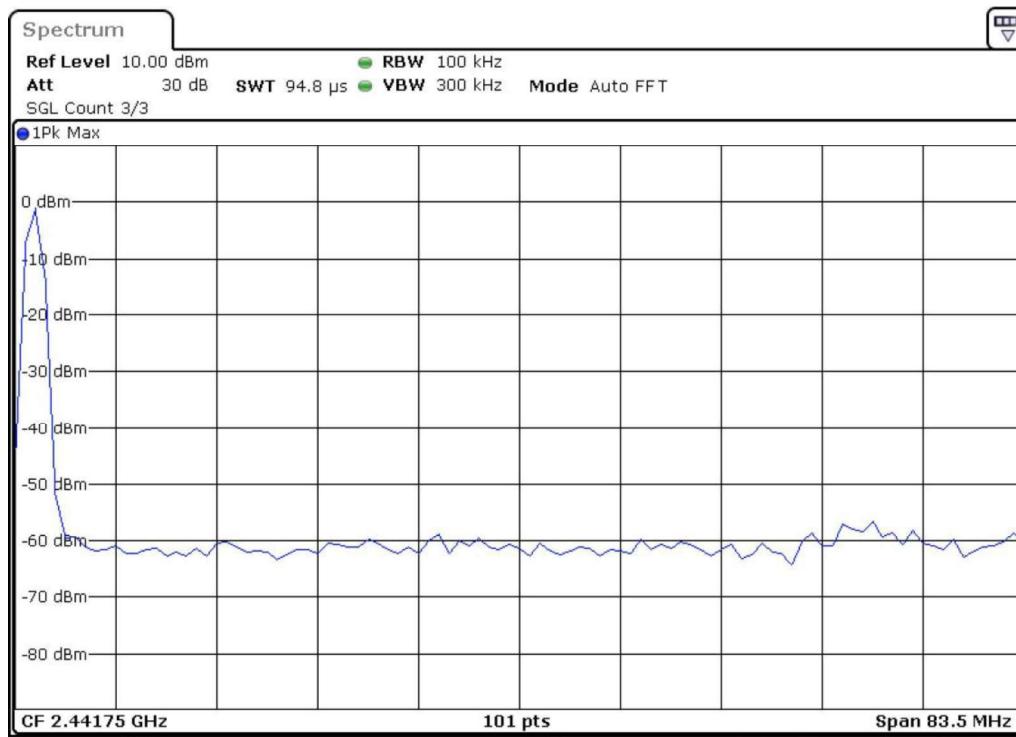
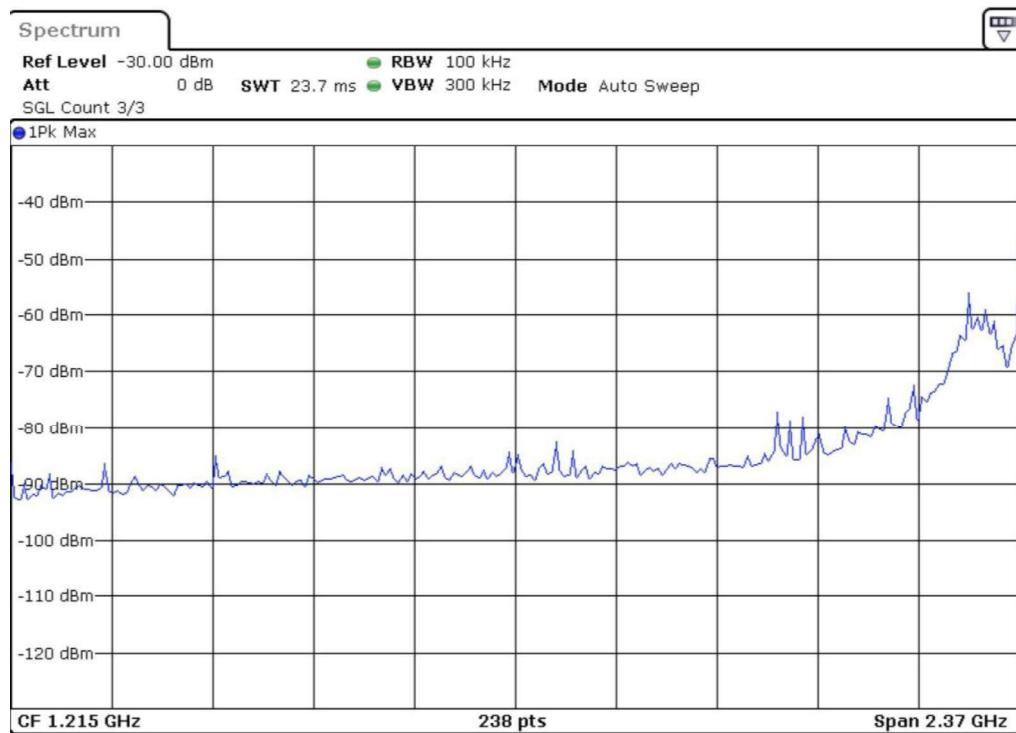
For the test equipment refer to chapter 1.3

3.3.3 Test results

Channel 2402 MHz:

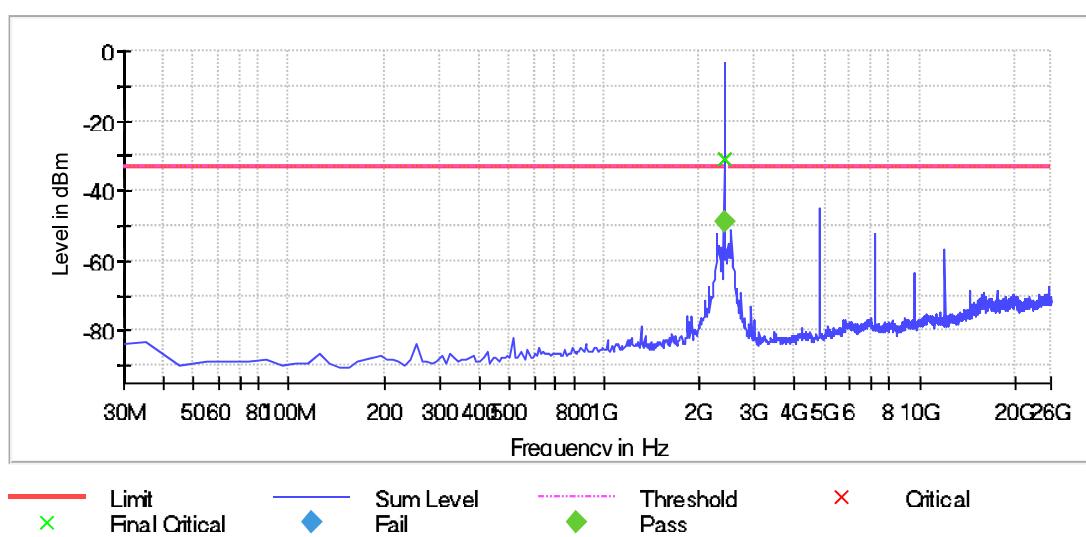
1 MHz:



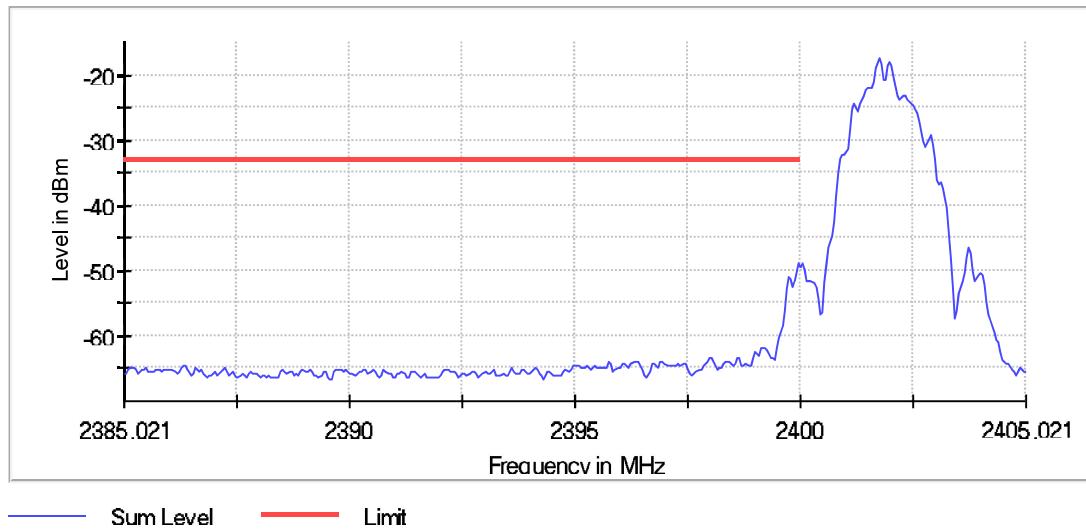


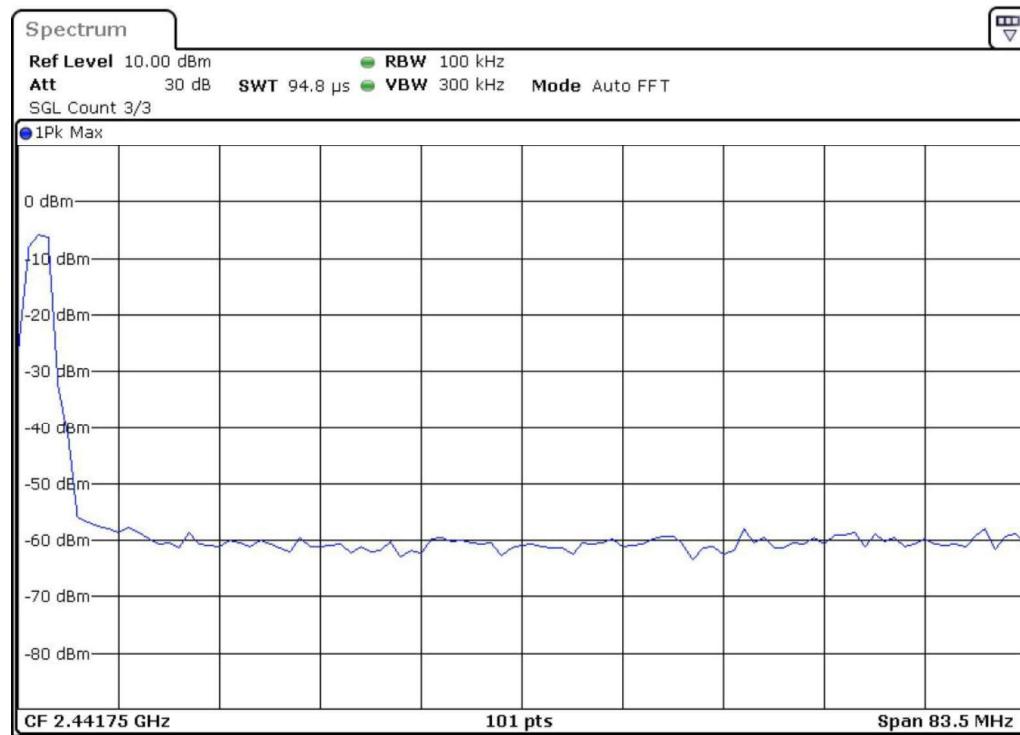
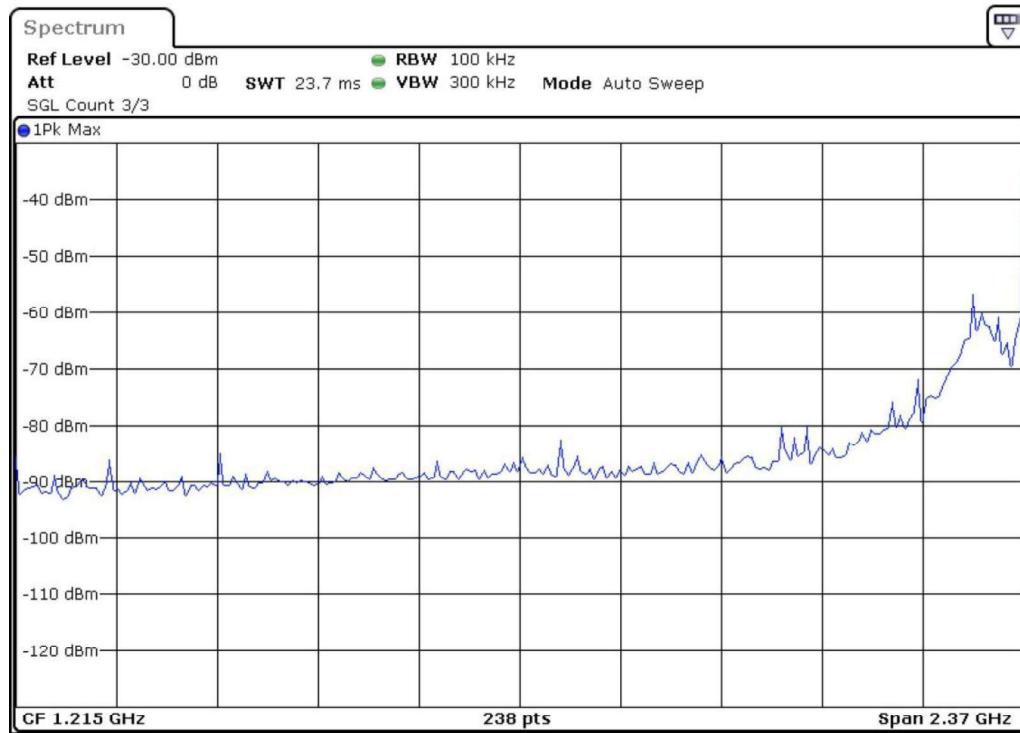
2 MHz:

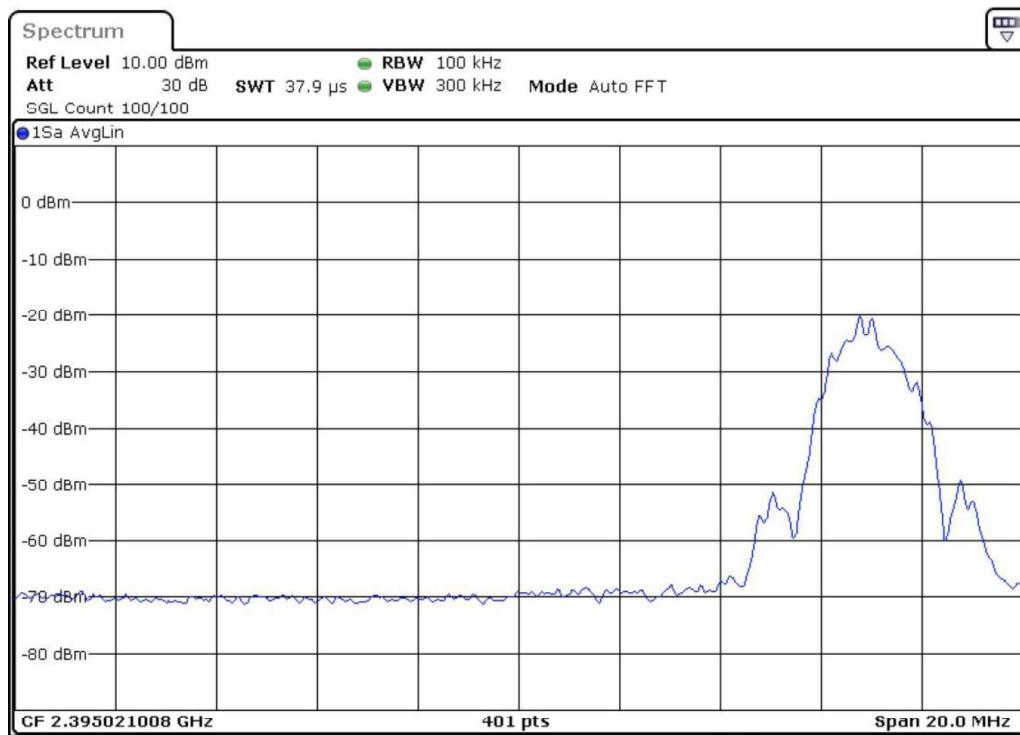
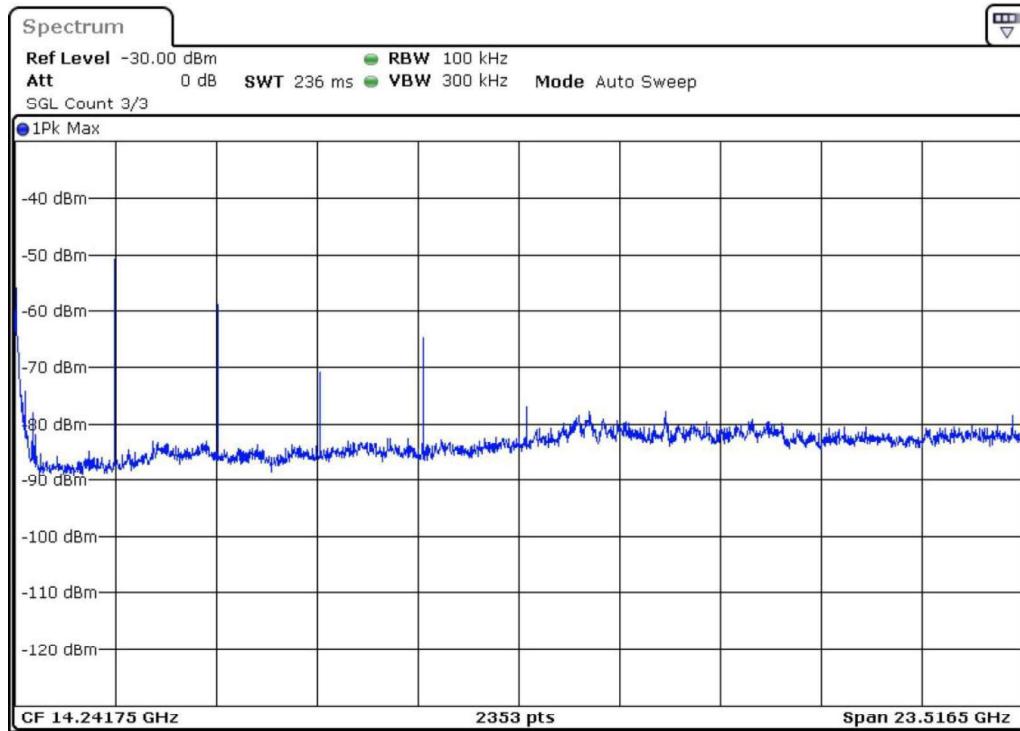
SIRIUS



FinalMeas 2395021008Hz

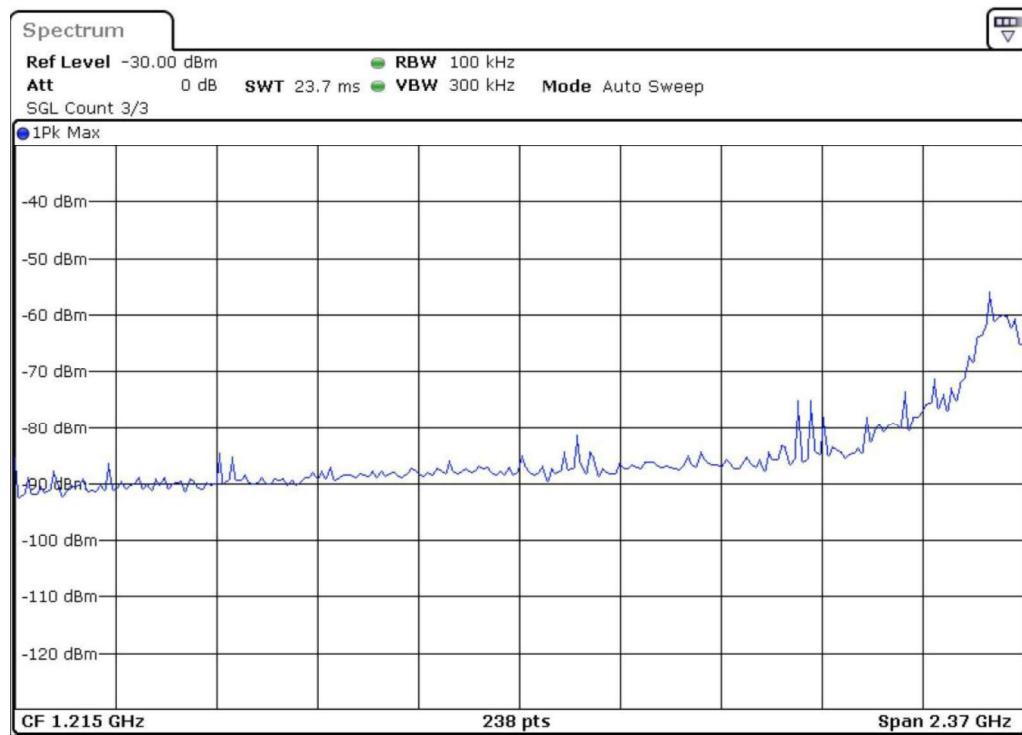
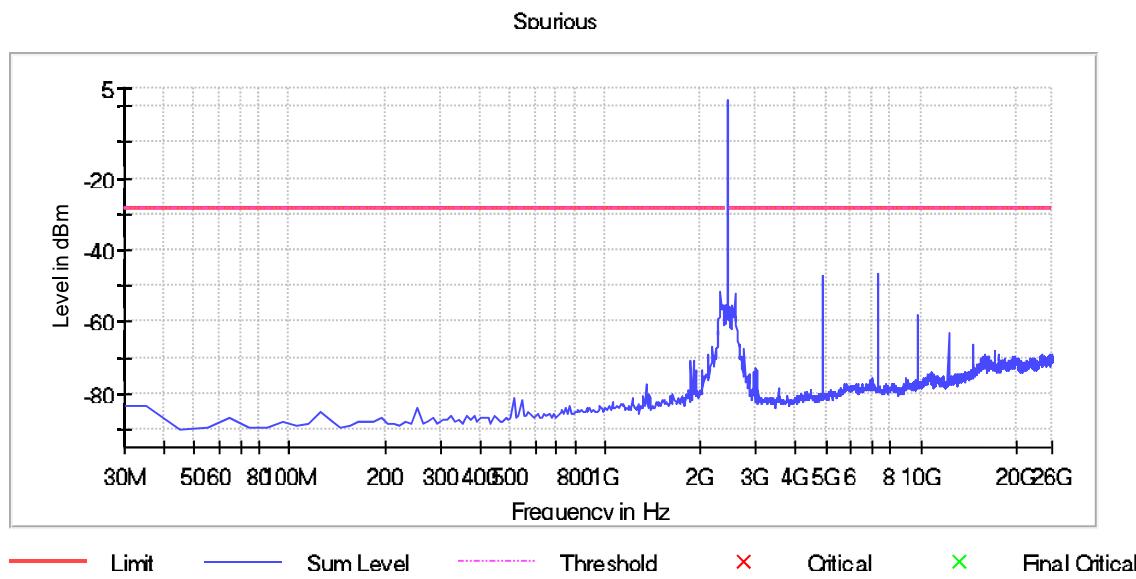


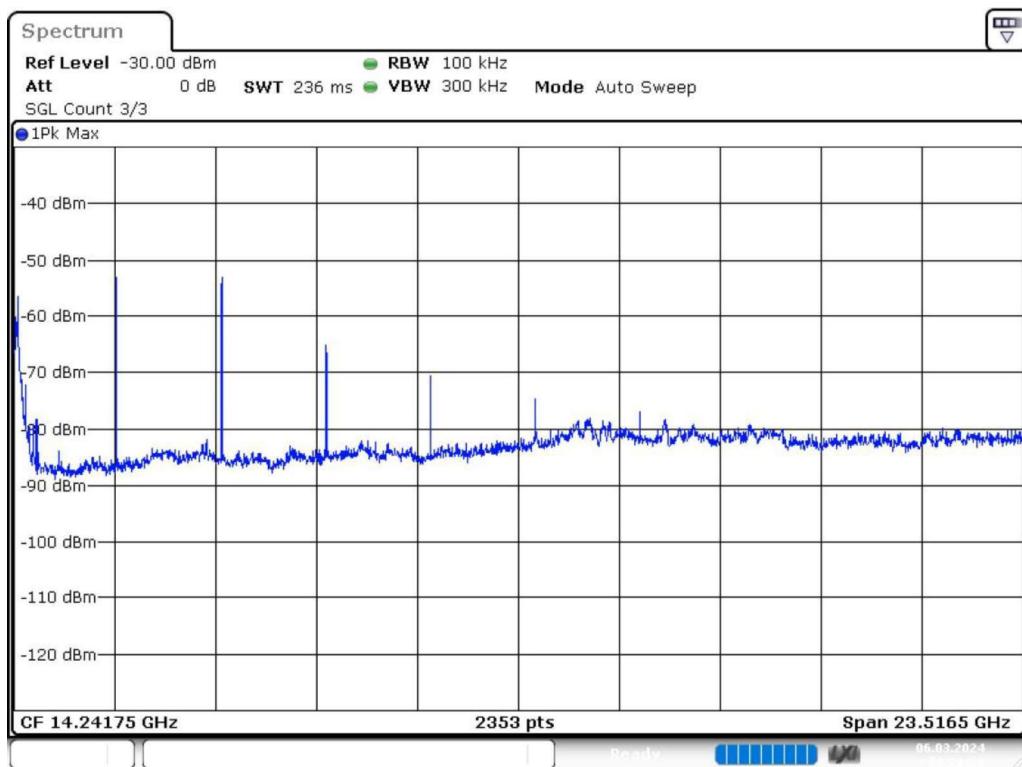
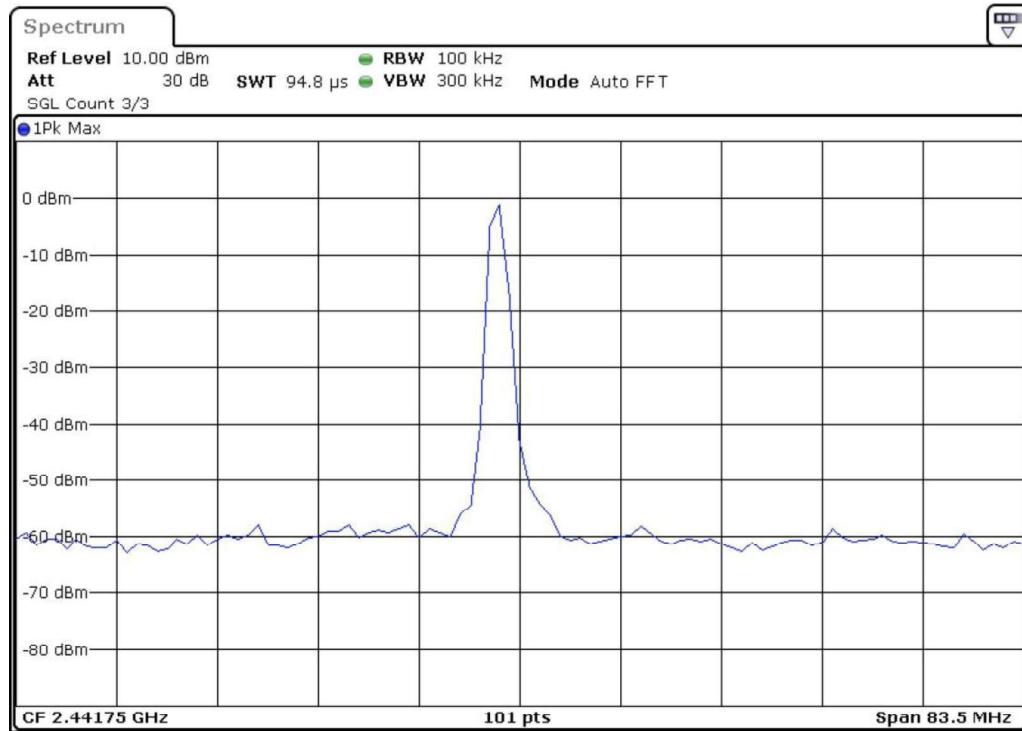




Channel 2440 MHz:

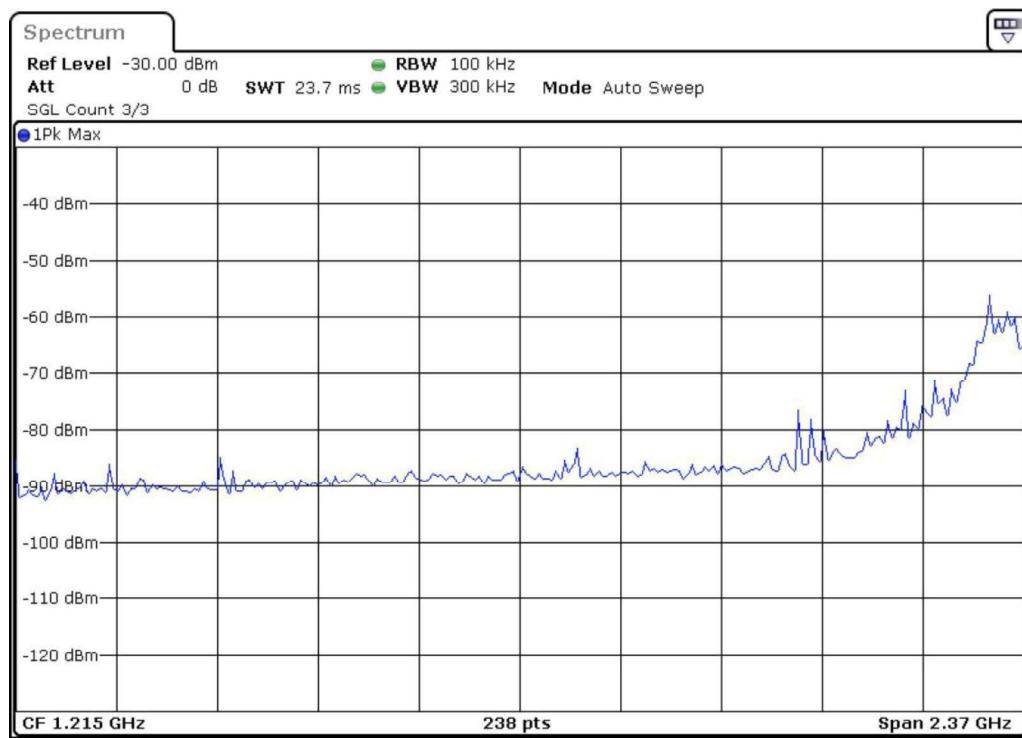
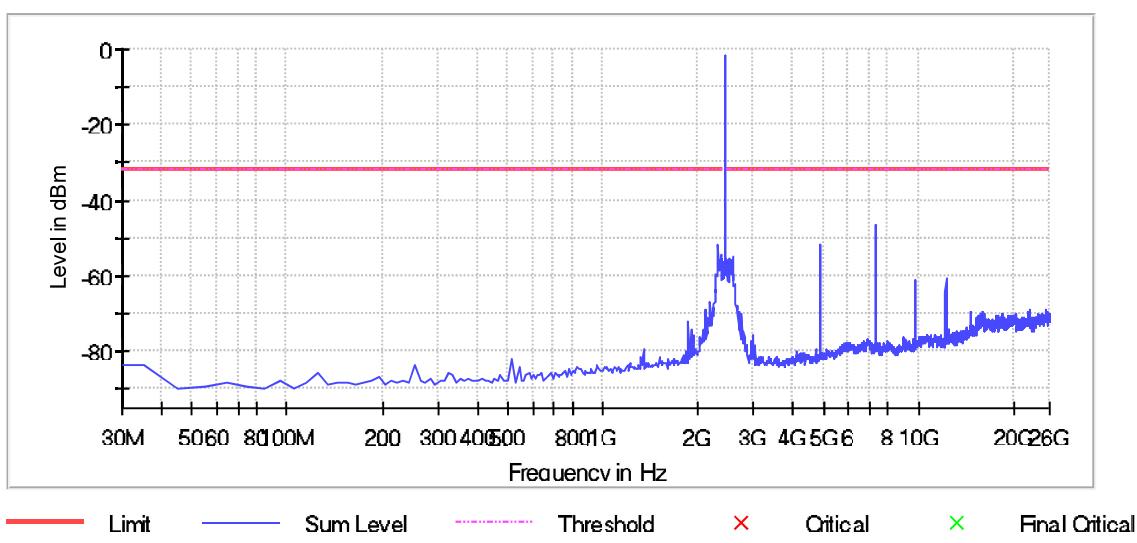
1 MHz:

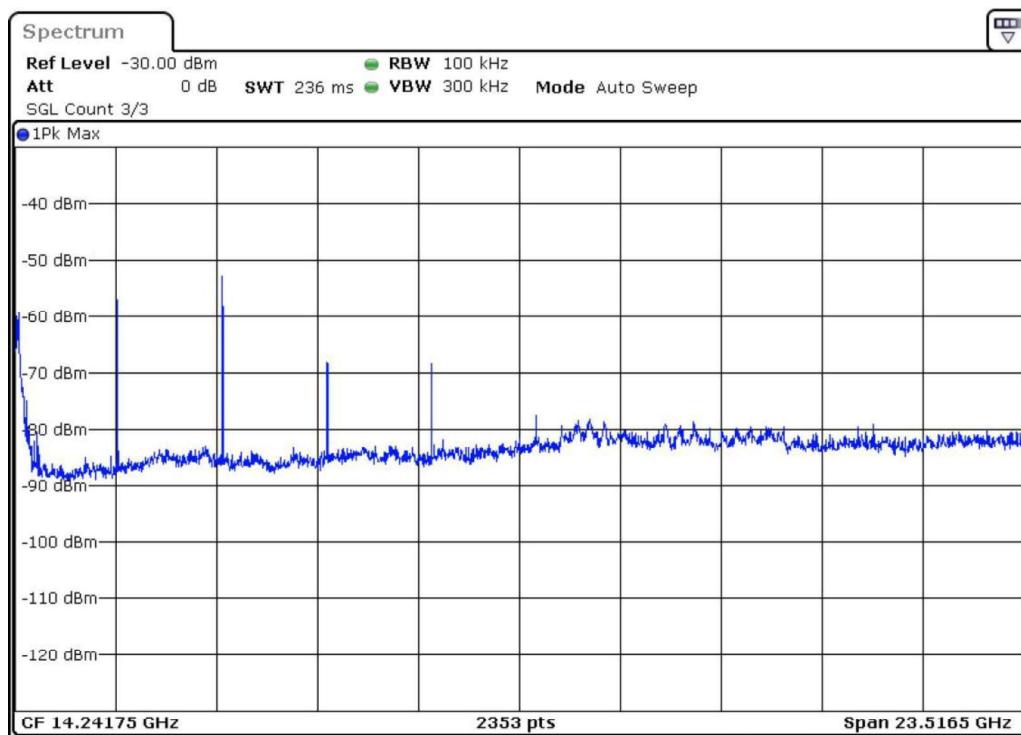
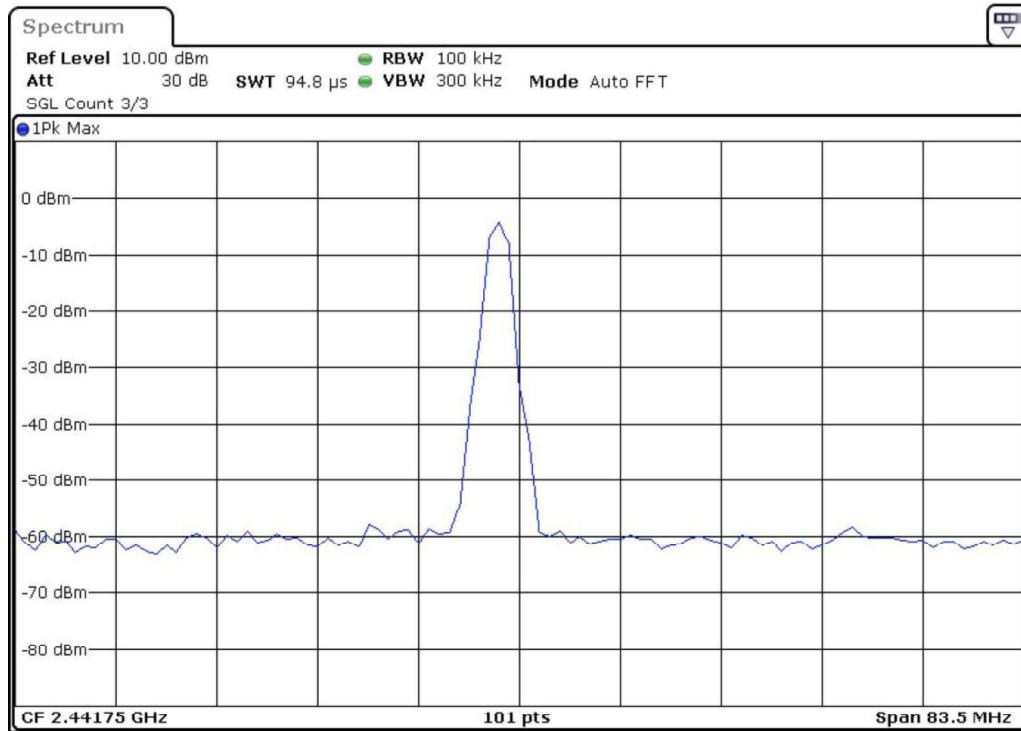




2 MHz

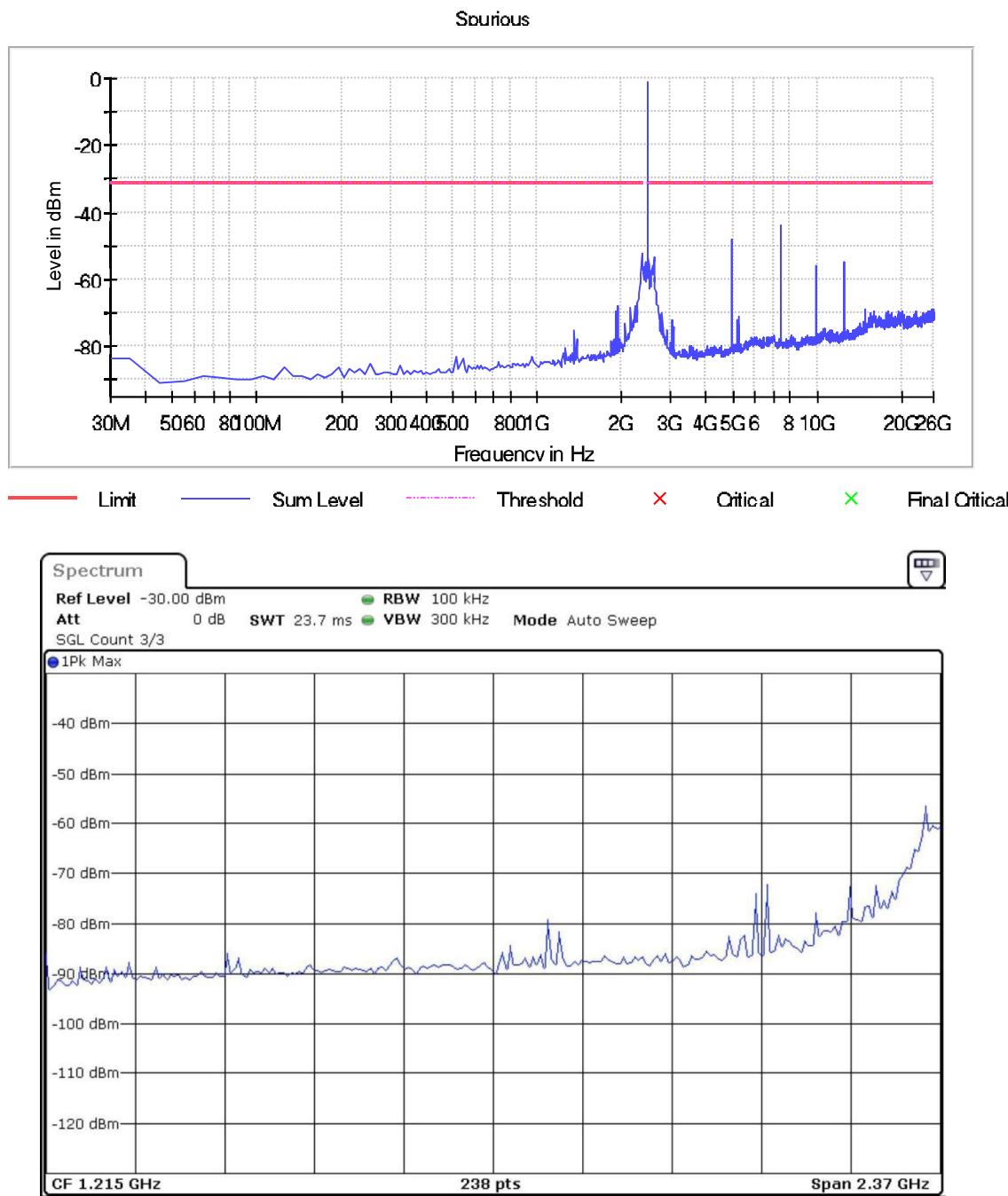
Spurious

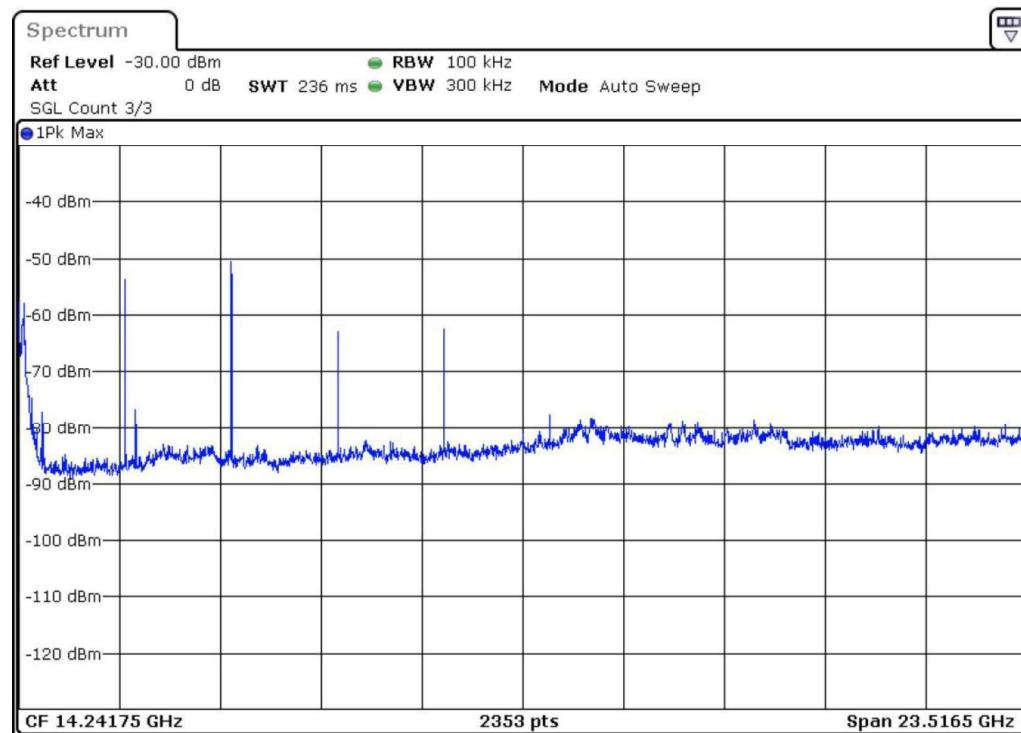
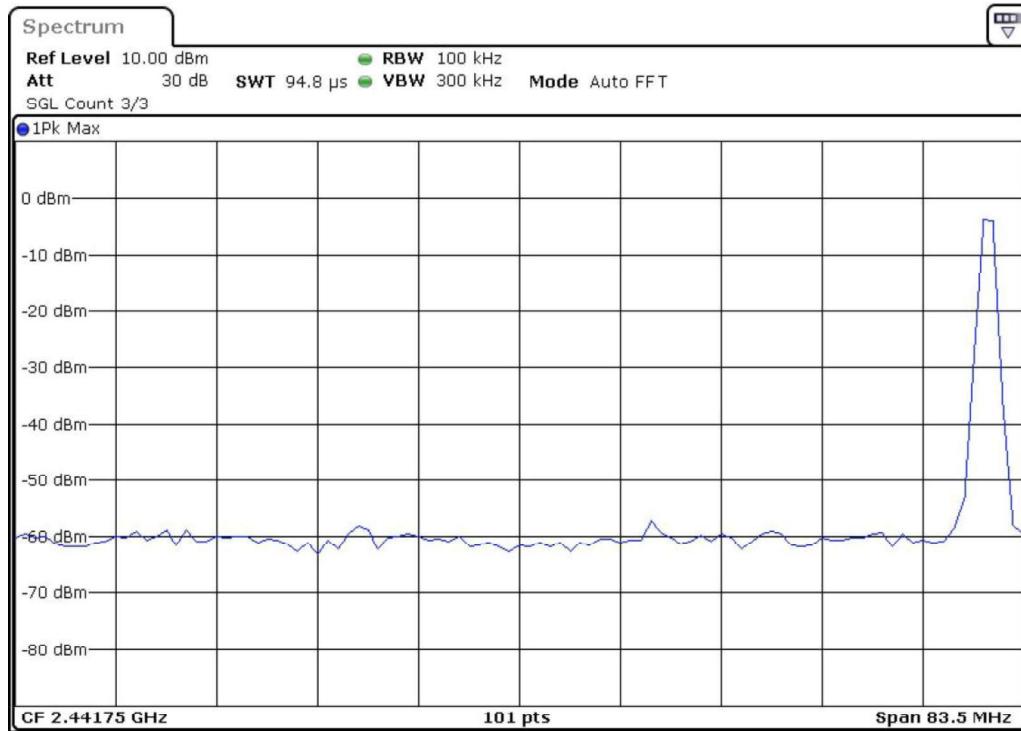




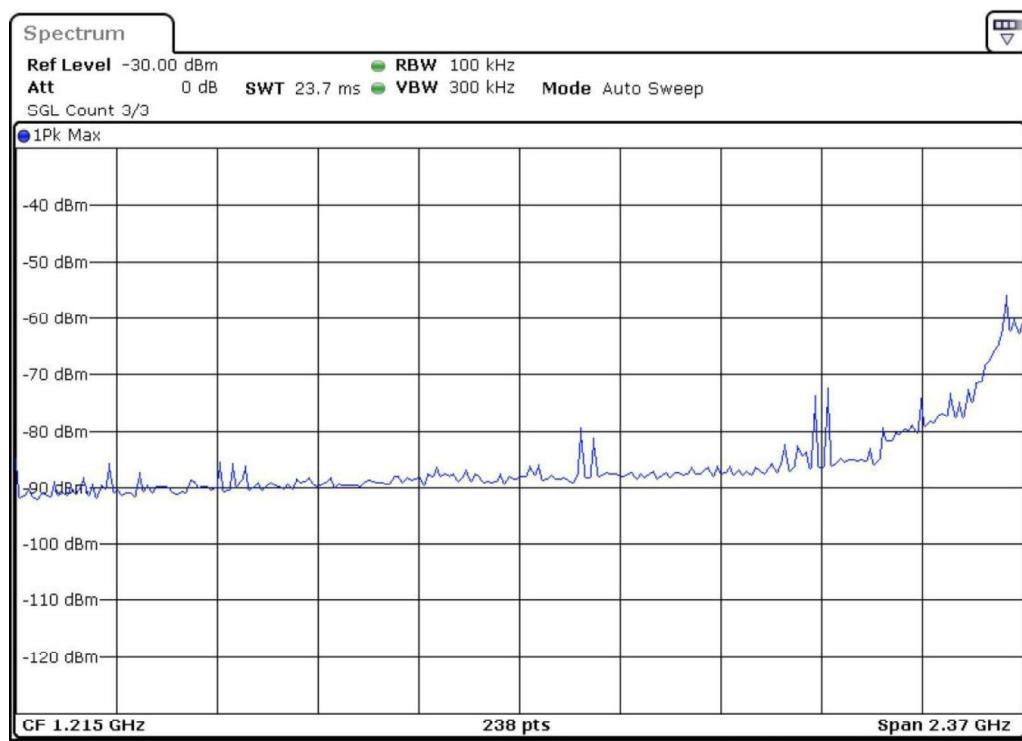
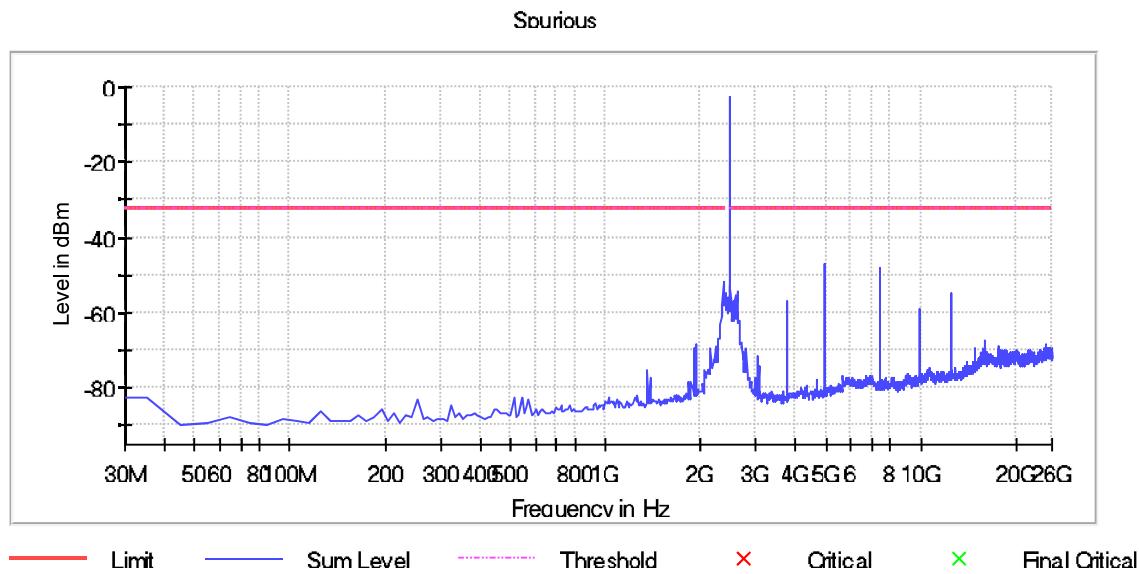
Channel 2480 MHz:

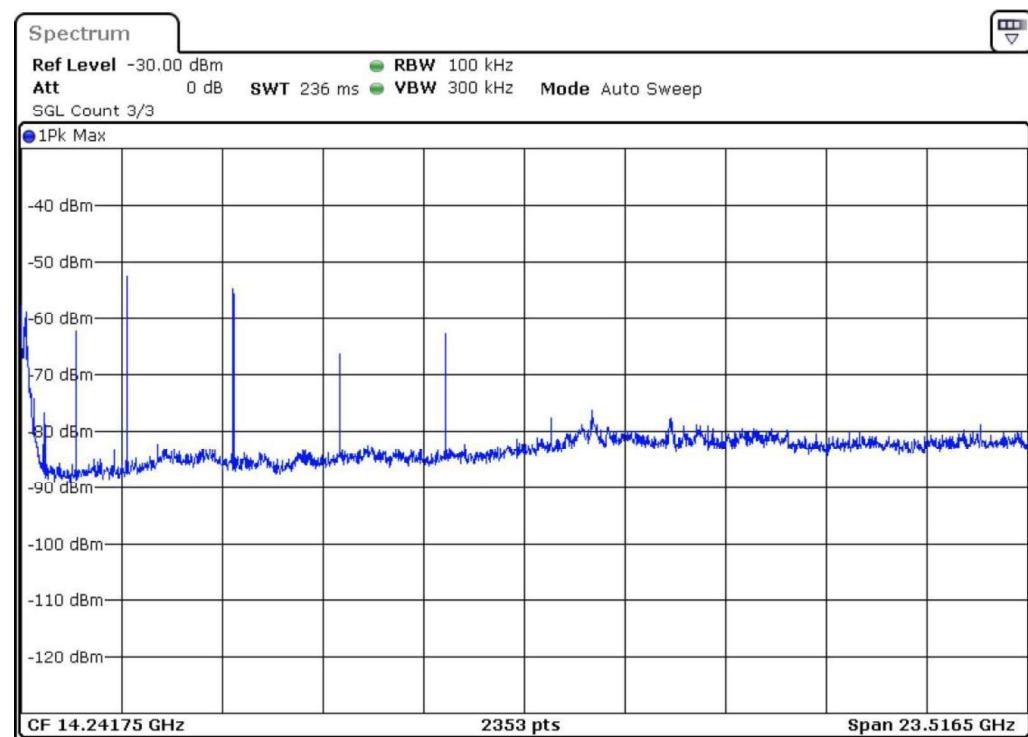
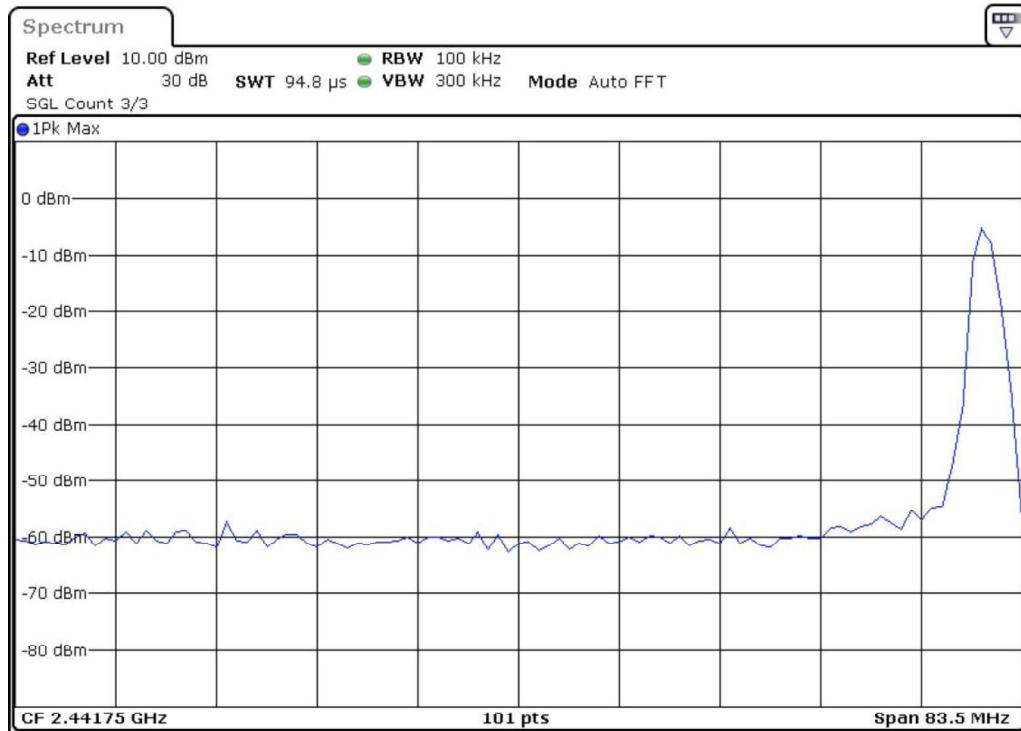
1 MHz:





2 MHz:





3.4 47 CFR § 15.205, § 15.209, § 15.247 (d) – Spurious emission - Radiated**§ 15.247 (d):**

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)).

§ 15.205:

Except as provided in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in § 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in § 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in § 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in § 15.35 apply to these measurements.

§ 15.209:

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

| Frequency (MHz) | Field strength (microvolts/ meter) | Measurement distance (meters) |
|-----------------|------------------------------------|-------------------------------|
| 0.009-0.49 | 2400/F(kHz) | 300 |
| 0.49-1.705 | 24000/F(kHz) | 30 |
| 1.705-30 | 30 | 30 |
| 30-88 | 100* | 3 |
| 88-216 | 150* | 3 |
| 216-960 | 200* | 3 |
| Above 960 | 500 | 3 |

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

§ 15.35:

Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz. When average radiated emission measurements are specified in this part, including average emission measurements below 1000 MHz, there also is a limit on the peak level of the radio frequency emissions. Unless otherwise specified, e.g., see §§ 15.250, 15.252, 15.253(d), 15.255, 15.256, and 15.509 through 15.519, the limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device, e.g., the total peak power level. Note that the use of a pulse desensitization correction factor may be needed to determine the total peak emission level. The instruction manual or application note for the measurement instrument should be consulted for determining pulse desensitization factors, as necessary.

3.4.1 Test procedure

According ANSI C63.10-2013:

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

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

The emission signal shall be kept within the illumination area of the 3 dB beamwidth of the antenna so that the maximum emission from the EUT is measured. This may be achieved by either pointing the

3.4.2 Test setup

For the test setup refer to chapter 1.4.

3.4.3 Test equipment

For the test equipment refer to chapter 1.3.

3.4.4 Test results

Radiated measurement:

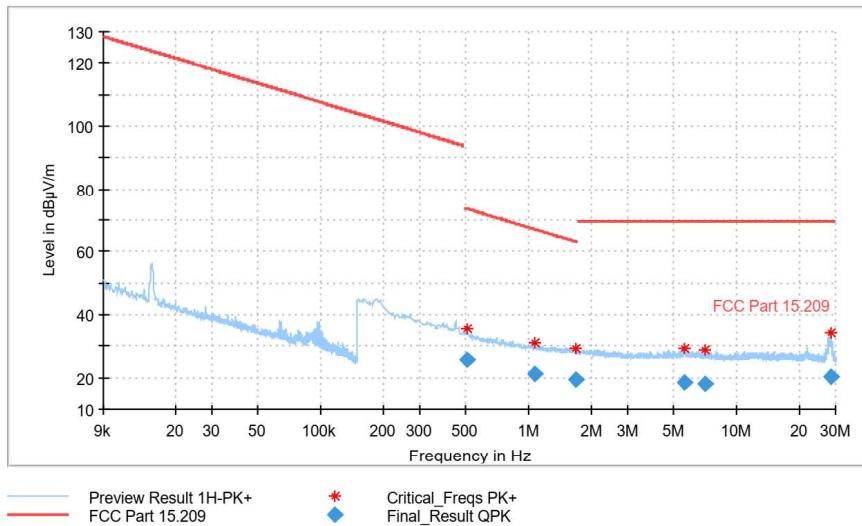
CT MIDI I AC:

Channel 2402 MHz:

EUT Information

EUT: FESTOOL CT MIDI I AC
Operating mode: TX 2402 MHz

Full Spectrum



Final Result

| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Pol | Azimuth (deg) |
|-----------------|--------------------|----------------|-------------|-----------------|-----------------|-----|---------------|
| 0.507750 | 25.81 | 73.49 | 47.68 | 1000.0 | 9.000 | H | 35.0 |
| 1.070250 | 21.27 | 67.03 | 45.76 | 1000.0 | 9.000 | H | 188.0 |
| 1.677750 | 19.42 | 63.14 | 43.72 | 1000.0 | 9.000 | H | 358.0 |
| 5.633250 | 18.43 | 69.50 | 51.07 | 1000.0 | 9.000 | H | 9.0 |
| 7.057500 | 18.00 | 69.50 | 51.50 | 1000.0 | 9.000 | H | 82.0 |
| 28.410000 | 20.08 | 69.50 | 49.42 | 1000.0 | 9.000 | H | 318.0 |

EUT Information

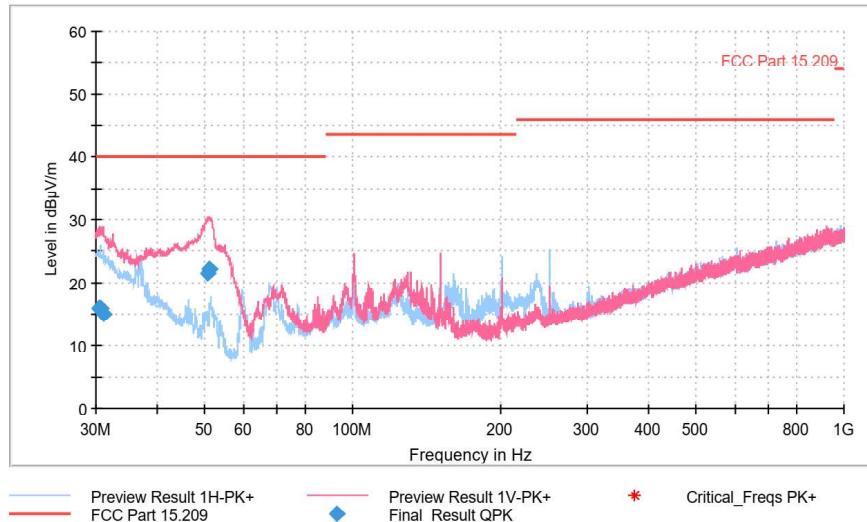
EUT:

Operating mode:

Festool CT MIDI I AC

TX, 2402 MHz

Full Spectrum



Final Result

| Frequency (MHz) | QuasiPeak (dB μ V/m) | Limit (dB μ V/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimut h (deg) | Corr. (dB/m) |
|-----------------|--------------------------|----------------------|-------------|-----------------|-----------------|-------------|-----|----------------|--------------|
| 30.360000 | 15.86 | 40.00 | 24.14 | 1000.0 | 120.000 | 100.0 | V | 53.0 | 19.7 |
| 30.630000 | 15.84 | 40.00 | 24.16 | 1000.0 | 120.000 | 100.0 | V | 49.0 | 19.5 |
| 31.170000 | 15.11 | 40.00 | 24.89 | 1000.0 | 120.000 | 100.0 | V | 9.0 | 19.2 |
| 50.820000 | 21.44 | 40.00 | 18.56 | 1000.0 | 120.000 | 100.0 | V | 235.0 | 7.4 |
| 50.940000 | 22.27 | 40.00 | 17.73 | 1000.0 | 120.000 | 100.0 | V | 232.0 | 7.3 |
| 51.150000 | 22.12 | 40.00 | 17.88 | 1000.0 | 120.000 | 100.0 | V | 232.0 | 7.2 |