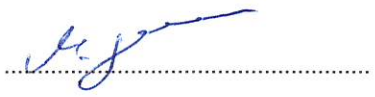
# EMC TEST REPORT

**Title 47 CFR Part 15B, ISED ICES-003 Issue 7**

| | |
|---|---|
| **Report Reference No** | G0M-2112-1232-EF0115B-V01 |
| **Testing Laboratory** | Eurofins Product Service GmbH |
| Address | Storkower Str. 38c<br>15526 Reichenwalde<br>Germany |
| Accreditation | A2LA - Registration number: 1983.01 (ISED)<br>ISED wireless device testing laboratory: CN 3470A<br>DAkkS - Registration number : D-PL-12092-01-04 (FCC)<br>FCC Filed Test Laboratory, Reg.-No.: 96970 |
| **Applicant** | WTO Werkzeug-Einrichtungen GmbH |
| Address | Neuer Hohdammweg 1<br>77797 Ohlsbach<br>Germany |
| **Test Specification**<br>Standard(s) | Title 47 CFR Part 15 Subpart B<br>ISED ICES-Gen Issue 1 ; Amendment 1 (February 2021)<br>ISED ICES-003 Issue 7<br>ANSI C63.4:2014+A1:2017 |
| Non-Standard Test Method | None |
| **Equipment under Test (EUT):** | |
| Product Description | SDTH Controller |
| Model(s) | WTO SC 002 |
| Additional Model(s) | None |
| Brand Name(s) | WTO |
| Hardware Version(s) | K / EH40 |
| Software Version(s) | 2.3.00 |
| FCC-ID | 2AZ56115715 |
| IC | 27343-115715 |
| **Test Result** | **PASSED** |

| | | |
|---|---|---|
| **Possible test case verdicts:** | | |
| required by standard but not tested | N/T | |
| not required by standard | N/R | |
| required by standard but not appl. to test object | N/A | |
| test object does meet the requirement | P(PASS) | |
| test object does not meet the requirement | F(FAIL) | |
| **Testing:** | | |
| Date of receipt of test item | 2022-05-18 | |
| **Report:** | | |
| Compiled by | Manuel Engel | |
| Tested by (+ signature)<br>(Responsible for Test) | Manuel Engel |  |
| Approved by (+ signature)<br>(Deputy Head of Lab) | Jens Marquardt |  |
| Date of Issue | 2022-07-25 | |
| Total number of pages | 30 | |
| **General Remarks:** | | |
| **The test results presented in this report relate only to the object tested.**<br>**The results contained in this report reflect the results for this particular model and serial number. It is the responsibility of the manufacturer to ensure that all production models meet the intent of the requirements detailed within this report.**<br>This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory. | | |
| **Additional Comments:** | | |
| | | |

| Additional Variants (not tested and not evaluated variants) | | |
|---|---|---|
| **Not-tested Variant** | **Description** | |
| 1 | Product Type Description | SDTH Controller |
| | Model name | WTO SC 002 |
| | Brand name | Coromant Capto® DTH Plus |
| | Hardware Version | K / EH40 |
| | Software Version | 2.3.00 |
| 2 | Product Type Description | SDTH Controller |
| | Model name | WTO SC 002 |
| | Brand name | WTO |
| | Hardware Version | K / EH10 |
| | Software Version | 2.3.00 |
| 3 | Product Type Description | SDTH Controller |
| | Model name | WTO SC 002 |
| | Brand name | Coromant Capto® DTH Plus |
| | Hardware Version | K / EH10 |
| | Software Version | 2.3.00 |
| 4 | Product Type Description | SDTH Controller |
| | Model name | WTO SC 002 |
| | Brand name | WTO |
| | Hardware Version | K / EH30 |
| | Software Version | 2.3.00 |
| 5 | Product Type Description | SDTH Controller |
| | Model name | WTO SC 002 |
| | Brand name | Coromant Capto® DTH Plus |
| | Hardware Version | K / EH30 |
| | Software Version | 2.3.00 |
| 6 | Product Type Description | SDTH Controller |
| | Model name | WTO SC 002 |
| | Brand name | WTO |
| | Hardware Version | K / EH50 |
| | Software Version | 2.3.00 |
| 7 | Product Type Description | SDTH Controller |
| | Model name | WTO SC 002 |
| | Brand name | Coromant Capto® DTH Plus |
| | Hardware Version | K / EH50 |
| | Software Version | 2.3.00 |
| 8 | Product Type Description | SDTH Controller |
| | Model name | WTO SC 002 |
| | Brand name | WTO |
| | Hardware Version | K / EH63 |
| | Software Version | 2.3.00 |
| 9 | Product Type Description | SDTH Controller |
| | Model name | WTO SC 002 |
| | Brand name | Coromant Capto® DTH Plus |
| | Hardware Version | K / EH63 |
| | Software Version | 2.3.00 |
| Comment: Those named additional variants above have not been tested. Those additional variants of the series have been declared by the manufacturer. The test report explicitly states that those variants were neither tested nor assessed nor evaluated. | | |

## ABBREVIATIONS AND ACRONYMS

| Acronyms | |
|---|---|
| Acronym | Description |
| EUT | Equipment Under Test |
| FCC | Federal Communications Commission |
| ISED | Innovation, Science and Economic Development Canada |
| $T_{NOM}$ | Nominal operating temperature |
| $V_{NOM}$ | Nominal supply voltage |

## VERSION HISTORY

| Version History | | | |
|---|---|---|---|
| Version | Issue Date | Remarks | Revised By |
| 01 | 2022-07-25 | Initial Release | - |

## REPORT INDEX

# 1 Equipment (Test Item) Under Test

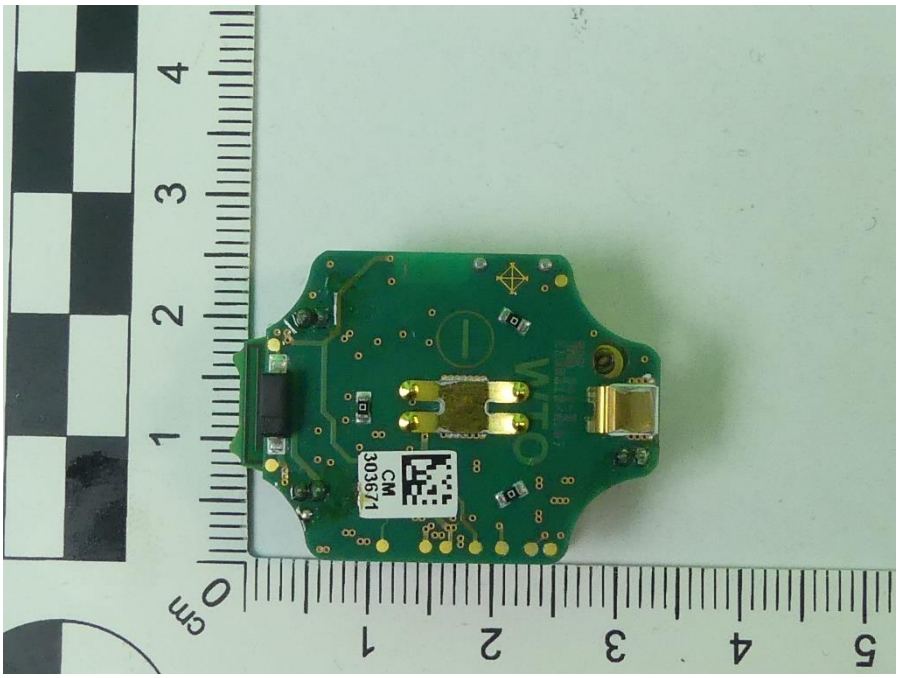
| | | | |
|---|---|---|---|
| Description | SDTH Controller | | |
| Intended Use | Smart Driven Tool Holders Controller<br>The electronic unit type WTO SC 002 enables the transmission of sensor data of tool holders based on Bluetooth® low energy 5.0 technology. This enables condition monitoring and predictive maintenance | | |
| Model | WTO SC 002 | | |
| Additional Model(s) | None | | |
| Brand Name(s) | WTO | | |
| Hardware Version(s) | K / EH40 | | |
| Software Version(s) | 2.3.00 | | |
| Number of tested samples | 1 | | |
| Sample Identification | EUT # | Sample-ID | Serial Number |
| | EUT 1 | 37517 | L22-000021-1.2 |
| EUT Dimensions [cm] | 4.2 x 3.5 x 1.95 | | |
| FCC-ID | 2AZ56115715 | | |
| IC | 27343-115715 | | |
| Class | Class B | | |
| Equipment type | Table top | | |
| Highest internal frequency [MHz] | 2483 | | |
| Protective Earth | No | | |
| Radio Module/ Chipset | Type | Bluetooth Low Energy | |
| | Model | EYSKBNZWB | |
| | Manufacturer | Taiyo Yuden | |
| | FCC-ID | RYYEYSKBN | |
| | IC | 4389B-EYSKBN | |
| Supply Voltage | $V_{NOM}$ | The Power Supply has a 3-stage concept: When the tool is not turned, a battery delivers the needed energy for the sleep mode. When the tool starts to turn, the energy harvester delivers voltages up to 140 V, which are rectified and DC/DC converted to 3.6 VDC. With this voltage the BLE controller is supplied and a SuperCap is charged until it reaches 3.5 V. When the tool is stopped, the Harvester's voltage goes down to 0 V, then the SuperCap delivers its energy until it is empty and then the battery takes the role of the Power Supply | |
| AC/DC-Adaptor | None | | |
| Manufacturer | WTO Werkzeug-Einrichtungen GmbH<br>Auf der oberen Au 45<br>77797 Ohlsbach<br>Germany | | |

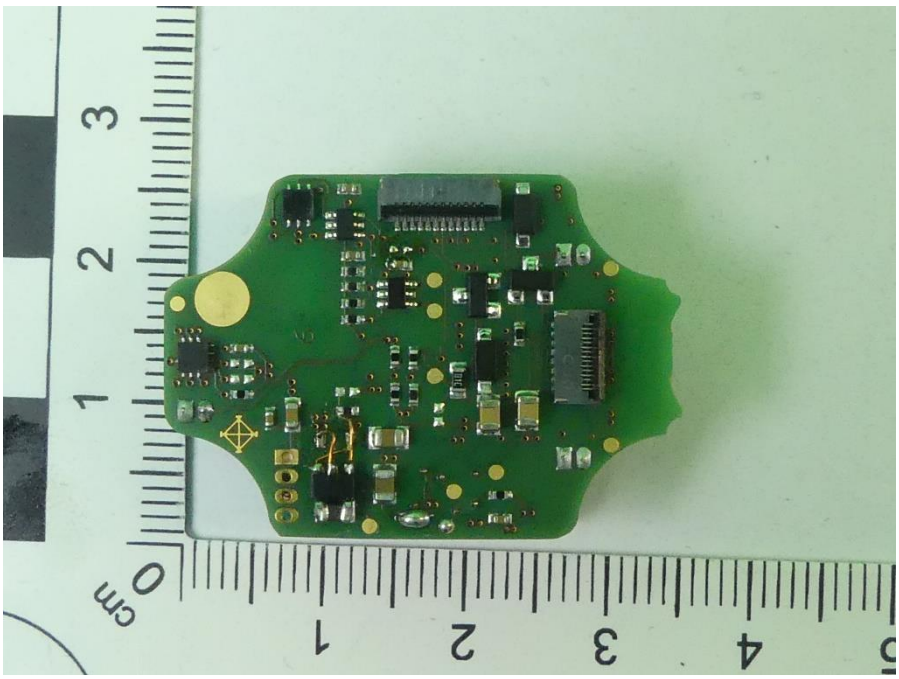
## 1.1 Equipment Ports

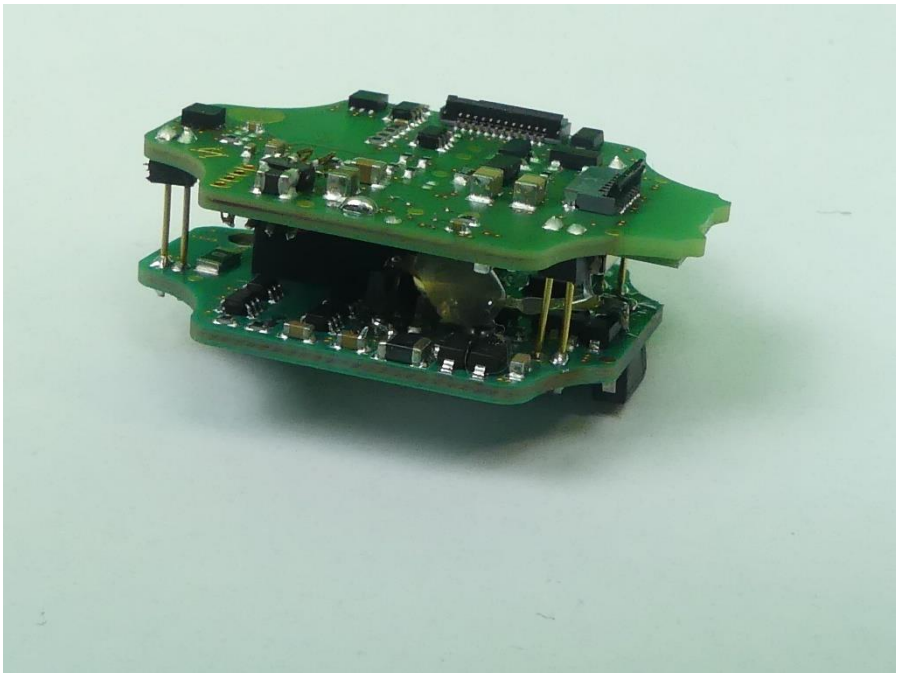
| Name | Type | Attributes | Comment |
|---|---|---|---|
| - | - | Count: -<br>Direction: -<br>Max. cable length [m]: -<br>Shielded: -<br>Service only: - | - |

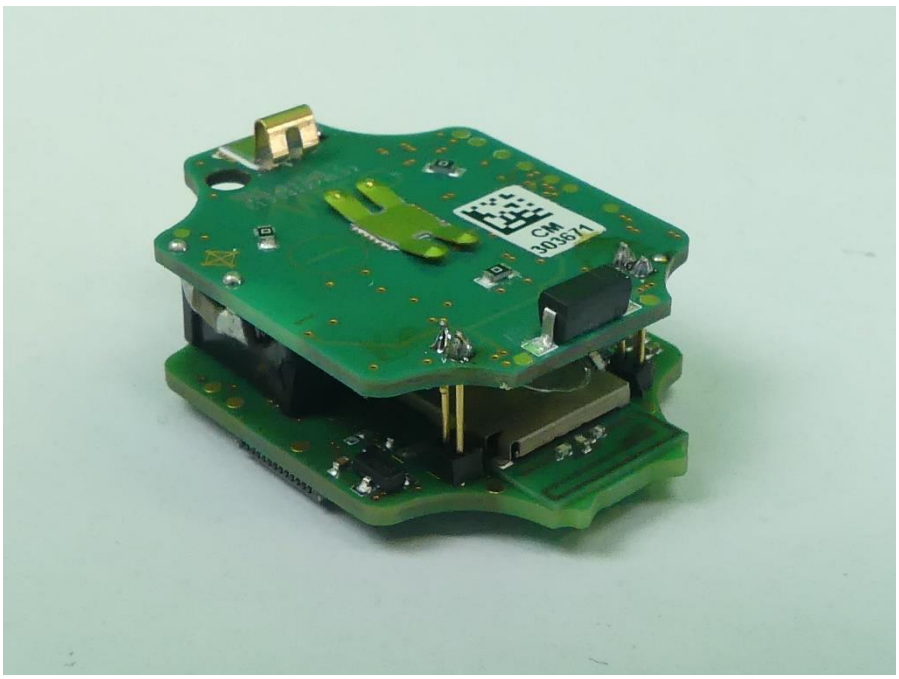
| Description: | |
|---|---|
| AC | AC mains power input/output port |
| DC | DC power input/output port |
| BAT | DC power input port connected to external battery |
| IO | Input/Output port |
| TP | Telecommunication port |
| NE | Non-electrical port |

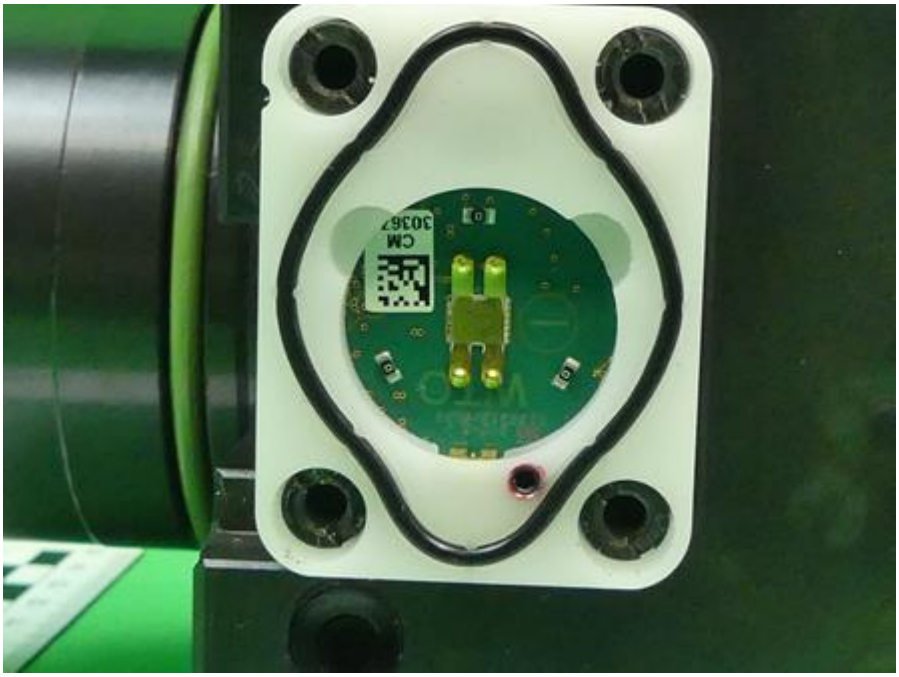
## 1.2 Equipment Photos - Internal

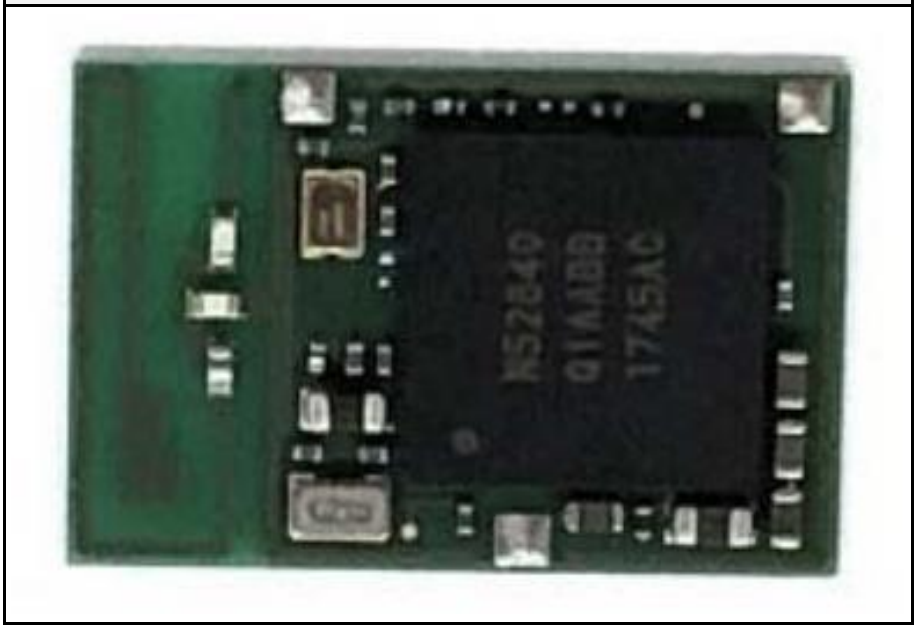
| EUT PCB Bluetooth bottom view |
| --- |
|  |

| EUT PCB Bluetooth top view |
| --- |
|  |

| EUT PCB Bluetooth view 1 |
| --- |
|  |

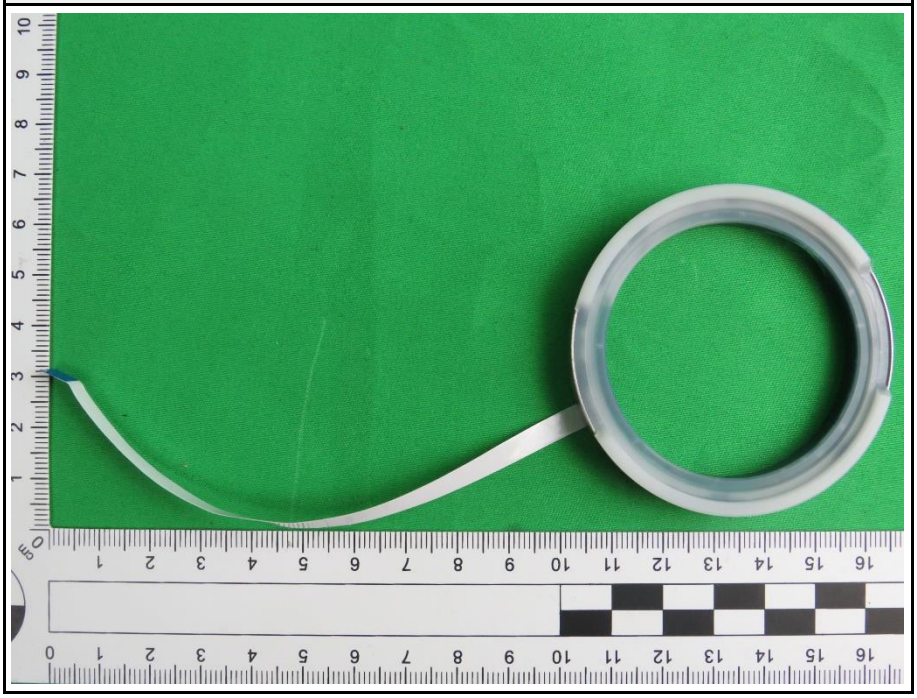
| EUT PCB Bluetooth view 2 |
| --- |
|  |

| EUT Electronic unit |
| --- |
|  |

| Bluetooth Module unshielded |
| --- |
|  |

**EUT Harvester bottom view**

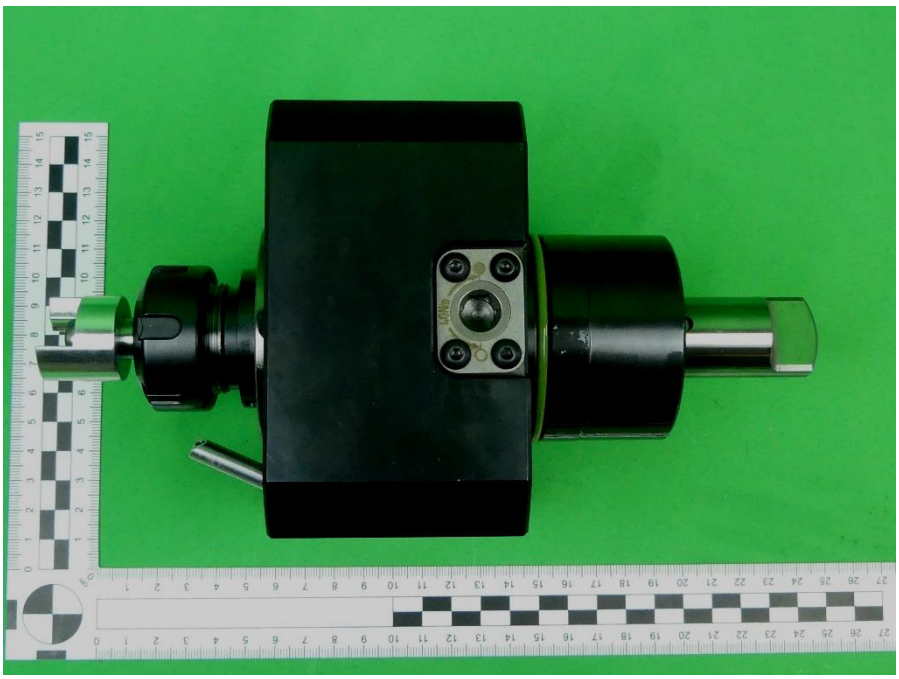
**EUT Harvester top view**

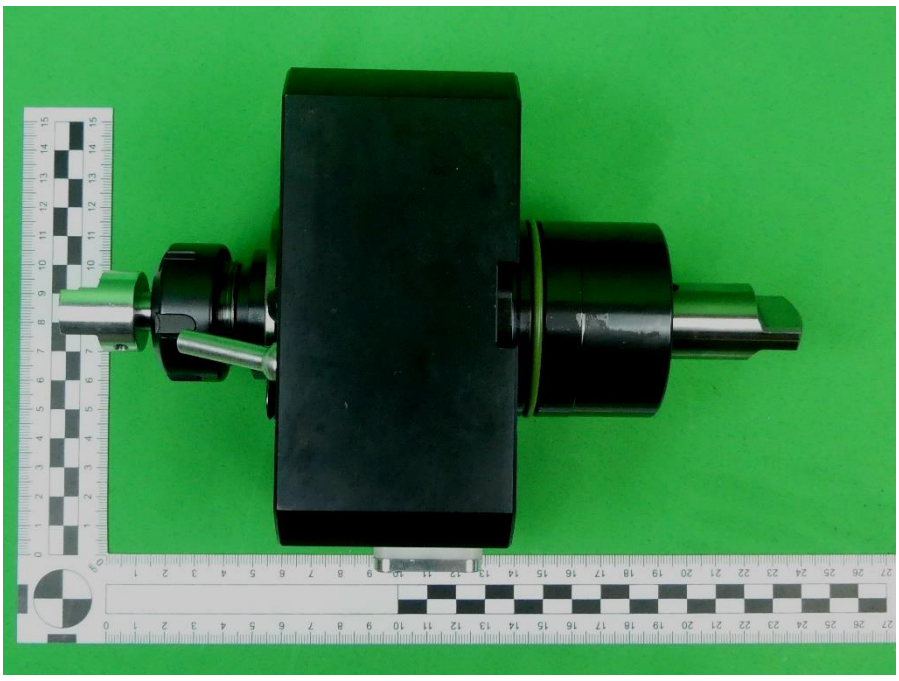


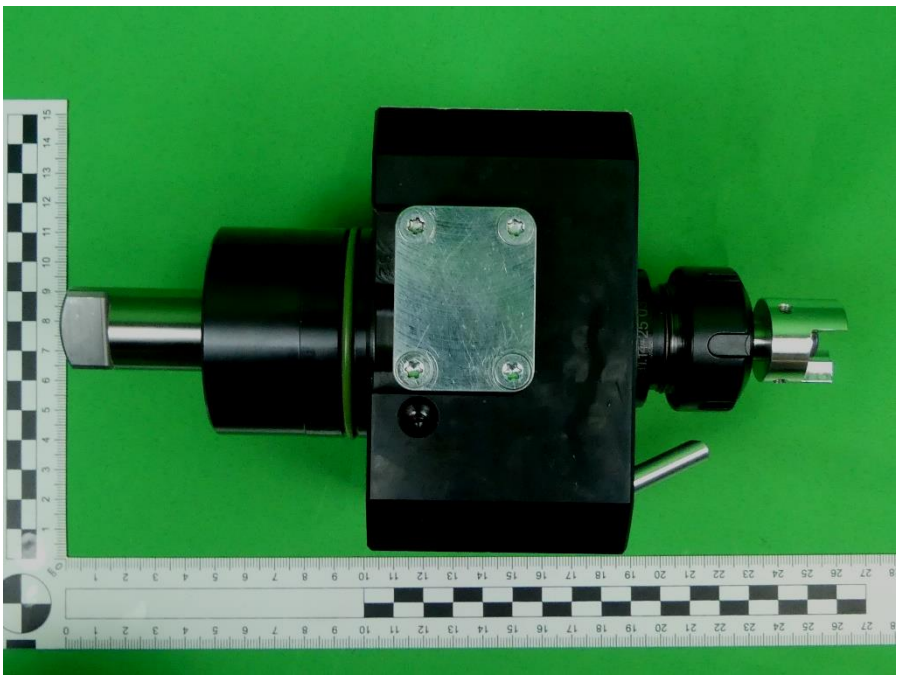
## 1.3 Equipment Photos - External

**EUT top view**

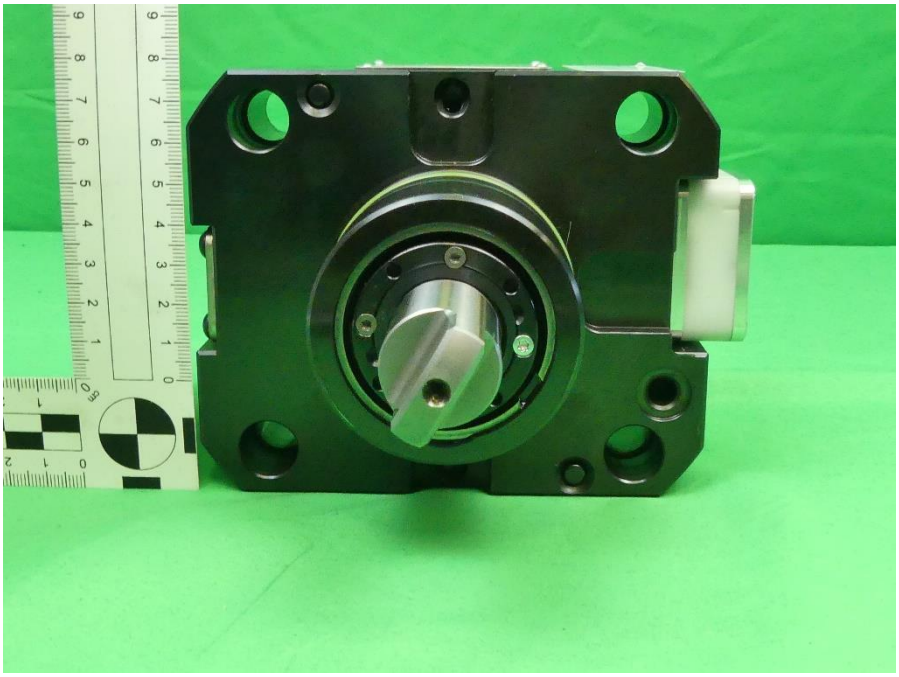

**EUT right view**



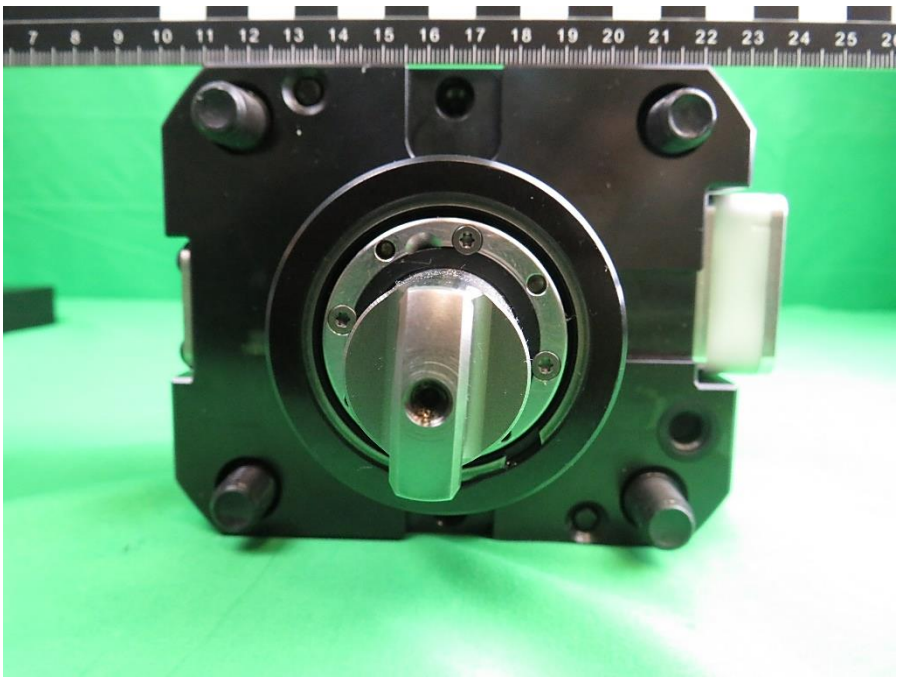
| EUT bottom view |
| --- |
|  |

| EUT left view |
| --- |
|  |

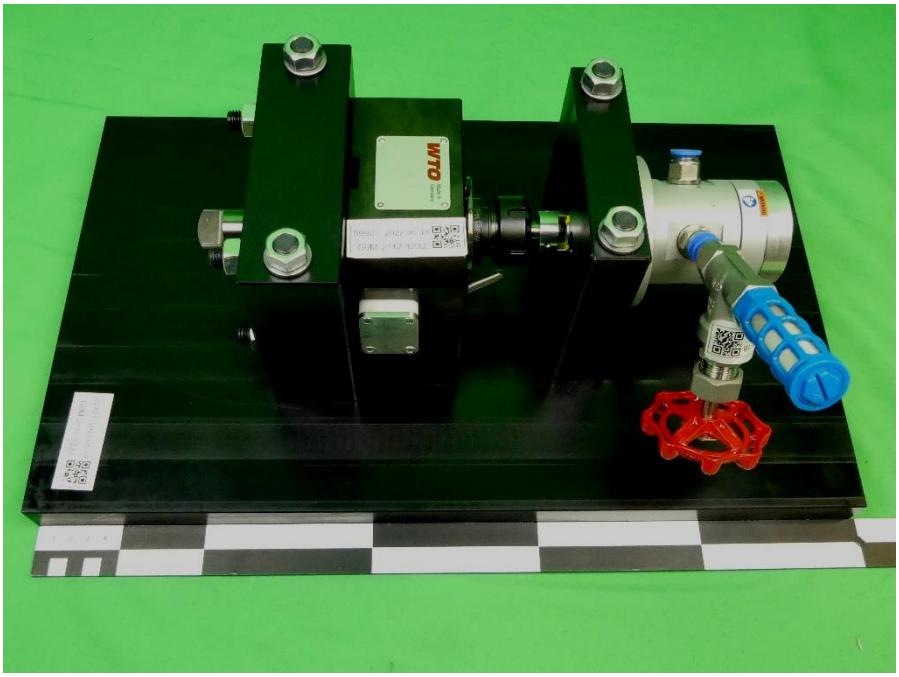
**EUT back view**



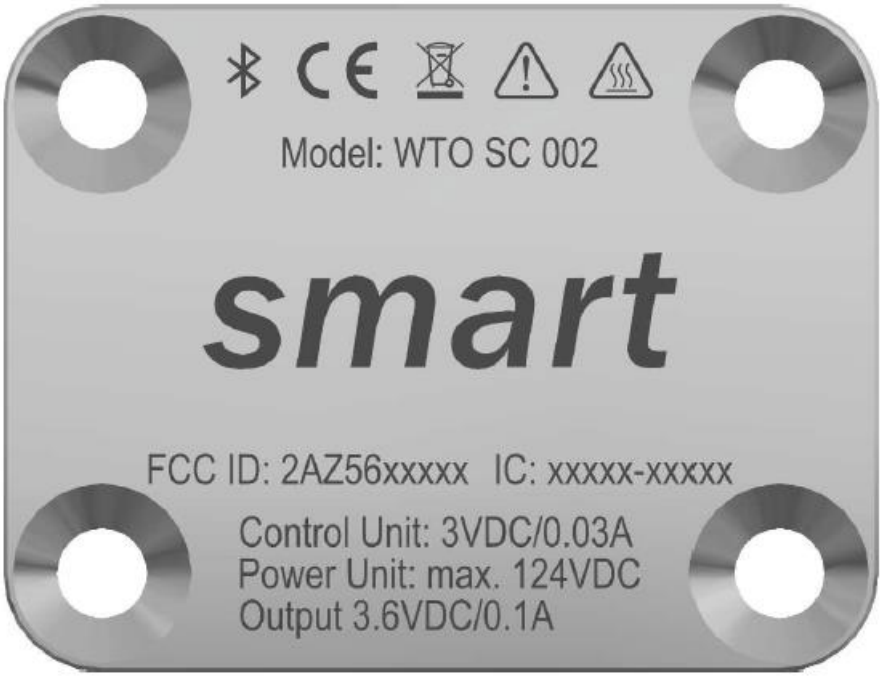
**EUT front view**



**EUT mounted on test stand**




**EUT draft labelling**



## 1.4 Support Equipment

| Product Type | Device | Manufacturer | Model | Comment |
|---|---|---|---|---|
| AE | Notebook | DELL | Latitude 7480 | Customer device |
| AE | Test stand | WTO | 116568 | Customer device |
| AE | Air motor | DEPRAG | 63X-001F05 | Customer device |
| SW | PC software | WTO | QuickFlex® smart | Version 22.3.27.2 |
| Description: | | | | |
| AE | Auxiliary Equipment | | | |
| SIM | Simulator | | | |
| MON | Monitoring Equipment | | | |
| CBL | Connecting Cable | | | |
| SW | Software | | | |
| Comment: - | | | | |

## 1.5 Operational Modes

| Mode # | Description |
|---|---|
| 1 | 2.4 GHz Bluetooth Low Energy<br>The BLE Controller transmits to notebook data like temperatures, accelerations and battery levels. Likewise time lengths, delays, work cycles and life cycles are measured and stored. |
| Comment: | |

## 1.6 EUT Configuration

| Configuration # | Description |
|---|---|
| 1 | Device mounted on a test stand with an air motor.<br>This one is driven by control air. The rotational speed was 4100 rpm ± 5 %. |
| Comment: | |

## 1.7 Sample emission level calculation

The following is a description of terms and a sample calculation, as appears in the radiated emissions data table. The numbers used in the calculation are for example only. There is no direct correlation to the specific data taken for the product described in this document:

Reading:

This is the reading obtained on the spectrum analyser in dBµV. Any external preamplifiers used are taken into account through internal analyser settings.

A.F.:

This is the antenna factor for the receiving antenna. It is a conversion factor, which converts electric fields strengths to voltages, which can be measured directly on the spectrum analyser. It is treated as a loss in dB. Cable losses have been included with the A.F. to simplify the calculations. The antenna factor is used in calculations as follows:

Reading on Analyser (dBµV) + A.F. (dB/m) = Net field strength (dBµV/m)

Net:

This is the net field strength measurement (as shown above).

Limit:

This is the FCC Class B radiated emission limit (in units of dBµV/m). The FCC limits are given in units of µV/m. The following formula is used to convert the units of µV/m to dBµV/m:

Limit (dBµV/m) = 20*log (µV/m)

Margin:

This is the margin of compliance below the FCC limit. The units are given in dB. A negative margin indicates the emission was below the limit. A positive margin indicates that the emission exceeds the limit.

Example only:

| | | | | |
|---|---|---|---|---|
| Reading + AF | = Net Reading | : | Net reading - FCC limit | = Margin |
| +21.5 dBµV + 26 dB/m | = 47.5 dBµV/m | : | 47.5 dBµV/m - 57.0 dBµV/m | = -9.5 dB |

## 2 Result Summary

| Title 47 CFR Part 15B, ISED ICES-003 Issue 7 | | | | |
|---|---|---|---|---|
| **Reference** | **Requirement** | **Reference Method** | **Result** | **Remarks** |
| Emission | | | | |
| FCC 15.109<br>ICES-003, 3.2.2 | Radiated emissions | ANSI C63.4:2014<br>+A1:2017 | PASS | - |
| FCC 15.107<br>ICES-003, 3.2.1 | AC power line conducted emissions | ANSI C63.4:2014<br>+A1:2017 | N/R | No relevant port |
| Comment: | | | | |

| Possible Test Case Verdicts | |
|---|---|
| PASS | Test object does meet the requirements |
| FAIL | Test object does not meet the requirements |
| N/T | Required by standard but not tested |
| N/R | Not required by standard for the test object |

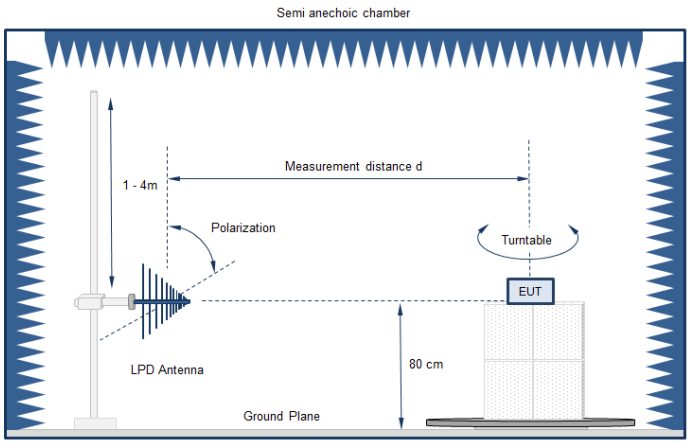
## 2.1 Test Conditions and Results - Radiated emissions acc. to ANSI C63.4

### 2.1.1 Information

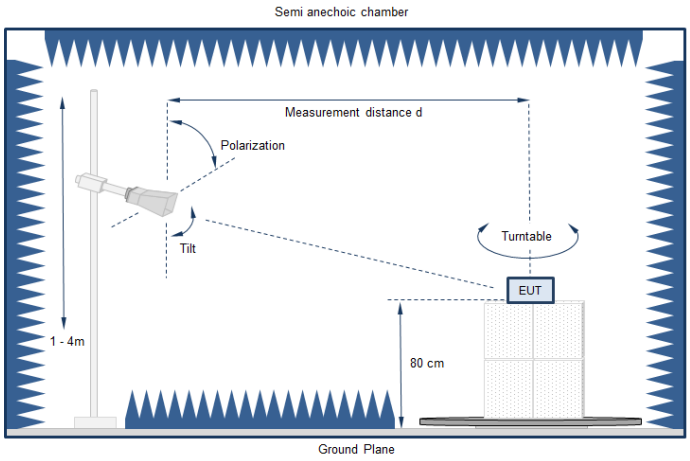
| Test Information | |
|---|---|
| Reference | FCC 15.109, ICES-003, 3.2.2 |
| Reference method | ANSI C63.4:2014+A1:2017 Section 8 |
| Equipment class | Class B |
| Equipment type | Table top |
| Highest internal frequency [MHz] | 2483.5 (2.4 GHz ISM band) |
| Measurement range | 30 MHz to 13000 MHz |
| Temperature [°C] | 23 ± 1 |
| Humidity [%] | 41 ± 2 |
| Operator | Manuel Engel |
| Date | 2022-05-30 |

### 2.1.2 Setup

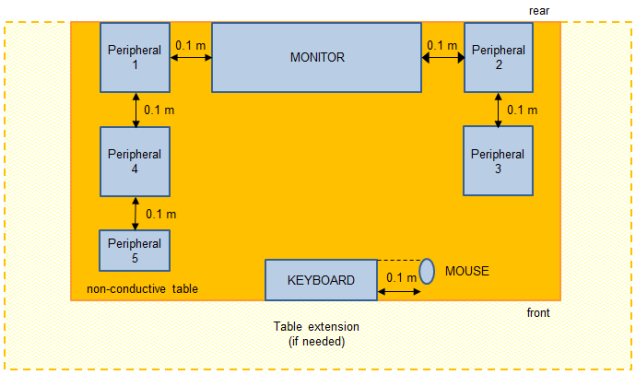
**Measurement up to 1 GHz**



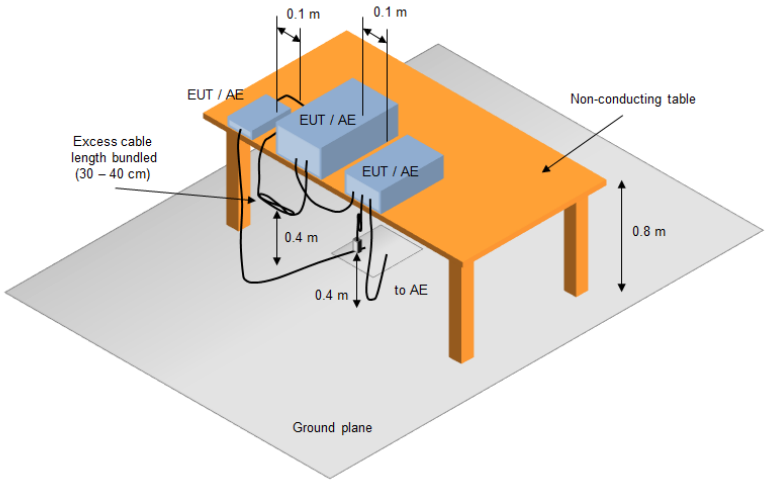

**Measurement above 1 GHz**



**Equipment placement - Table top**




**Test Setup**




2.1.3 Equipment

| Test Software | | | |
|---|---|---|---|
| Description | Manufacturer | Name | Version |
| EMC Software | DARE Instruments | Radimation | 2020.1.8 |

| Test Equipment | | | | | |
|---|---|---|---|---|---|
| Description | Manufacturer | Model | Identifier | Cal. Date | Cal. Due |
| Anechoic chamber (NSA) | Frankonia | AC6 | EF00910 | 2021-07 | 2024-07 |
| Anechoic chamber (SVSWR) | Frankonia | AC6 | EF00899 | 2021-07 | 2024-07 |
| EMI Test Receiver | R&S | ESU26 | EF00887 | 2021-07 | 2022-07 |
| TRILOG Broadband Antenna | Schwarzbeck | VULB 9162 | EF00978 | 2019-10 | 2022-10 |
| Horn Antenna | ETS-Lindgren | 3117 | EF00976 | 2019-03 | 2022-03 |
| Climatic Sensor | Embedded Data Systems, LLC. | 9A00100000254 77E | EF01124 | 2021-03 | 2022-05 |

2.1.4 Procedure

| Exploratory measurement |
|---|
| 1. The EUT was placed on a non-conductive table at a height of 0.8m.<br>2. The EUT and support equipment, if needed, were set up to simulate typical usage.<br>3. Cables, of type and length specified by the manufacturer, were connected to at least one port of each type and were terminated by a device or simulating load of actual usage.<br>4. The antenna was placed at a distance of 3 or 10 m.<br>5. The received signal was monitored at the measurement receiver.<br>6. This procedure has to be performed in both antenna polarizations, horizontal and vertical.<br>7. The arrangement of the equipment with the maximum emission level is shown on the setup picture at item 2.1.2 |

| Final measurement |
|---|
| 1. The EUT was placed on a 0.8 m non-conductive table at a 3 or 10 meter distance from the receive antenna. The antenna output was connected to the measurement receiver<br>2. A broadband hybrid antenna was used for the frequency range 30 – 1000 MHz. Above 1 GHz the antenna was placed on an adjustable height antenna mast. In the range 1- 18 GHz a double ridged broadband horn antenna was used. The antenna was placed on an adjustable height antenna mast.<br>3. The EUT and cable arrangement were based on the exploratory measurement results.<br>4. Emissions were maximized at each frequency by rotating the EUT and adjusting the receive antenna height and polarization. The maximum values were recorded.<br>5. The test data of the worst-case conditions were recorded and shown on the next pages. |

2.1.5 Limits

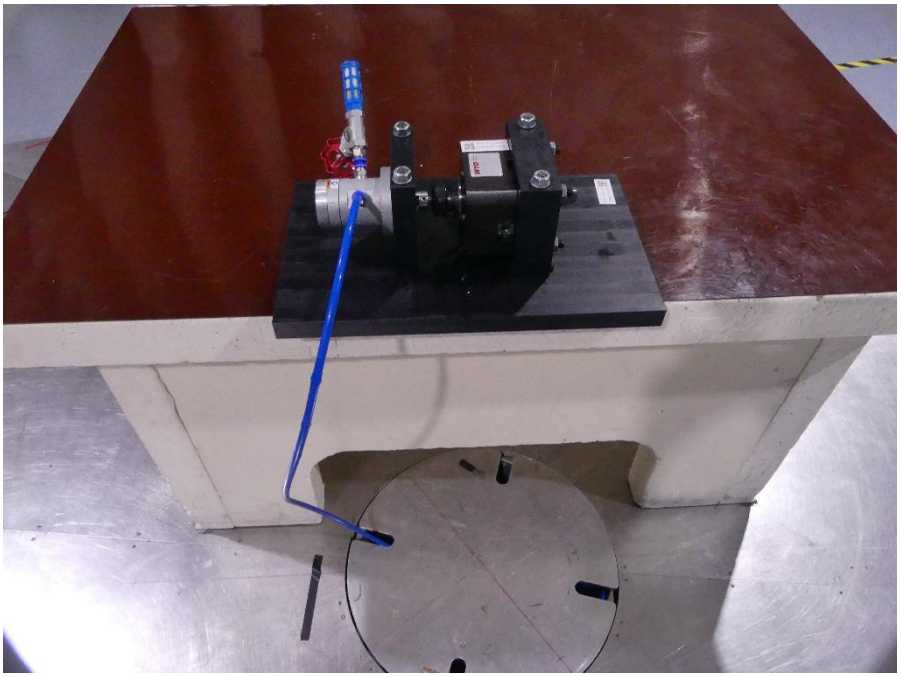
| Class B @ 3 m | | |
|---|---|---|
| Frequency [MHz] | Detector | Limit [dBµV/m] |
| 30 - 88 | Quasi-peak | 40 |
| 88 - 216 | Quasi-peak | 43.5 |
| 216 - 960 | Quasi-peak | 46 |
| 960 - 1000 | Quasi-peak | 54 |
| > 1000 | Peak<br>Average | 74<br>54 |

2.1.6 Results

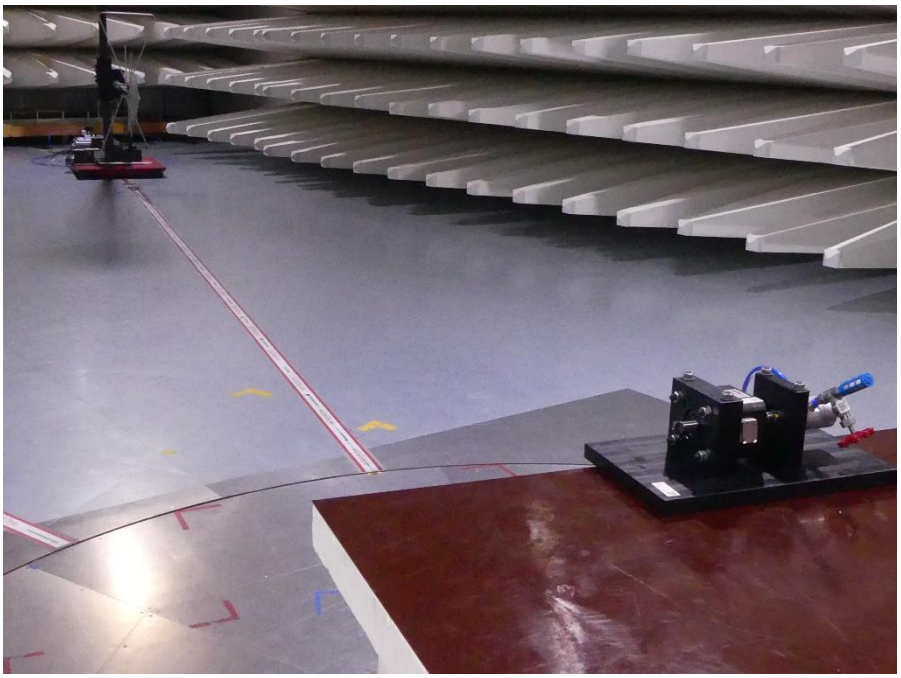
| Test Results | | | |
|---|---|---|---|
| Operational mode | EUT Configuration | Verdict | Remark |
| 1 | 1 | PASS | - |

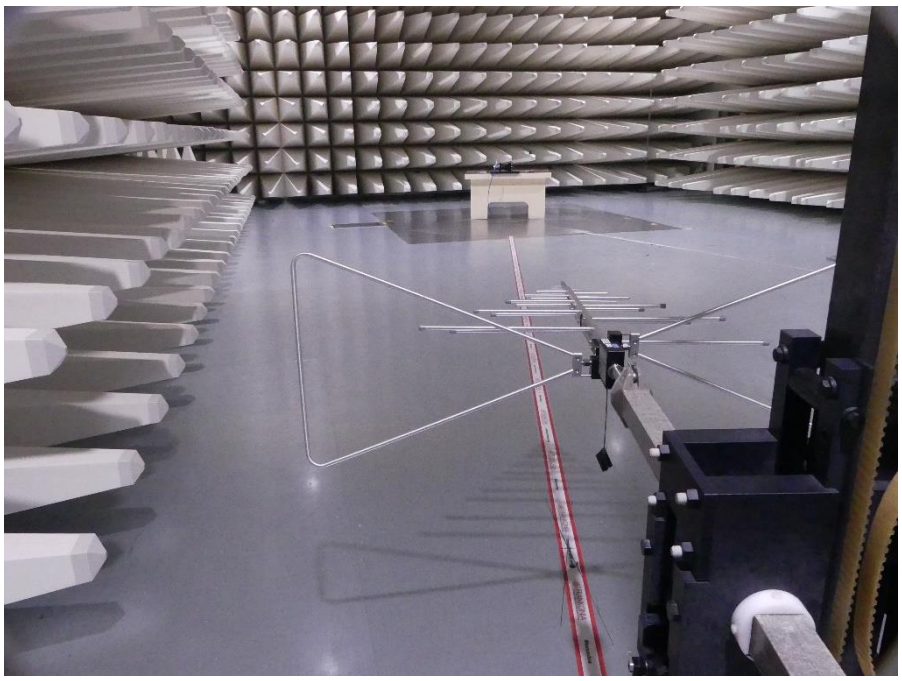
2.1.7 Setup Photos

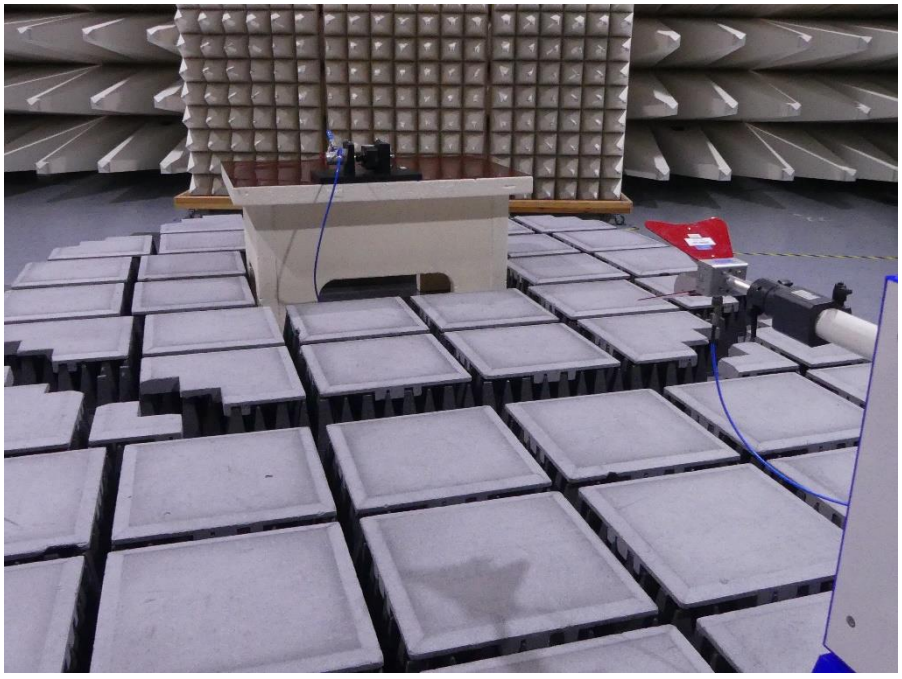
**Arrangement EUT**

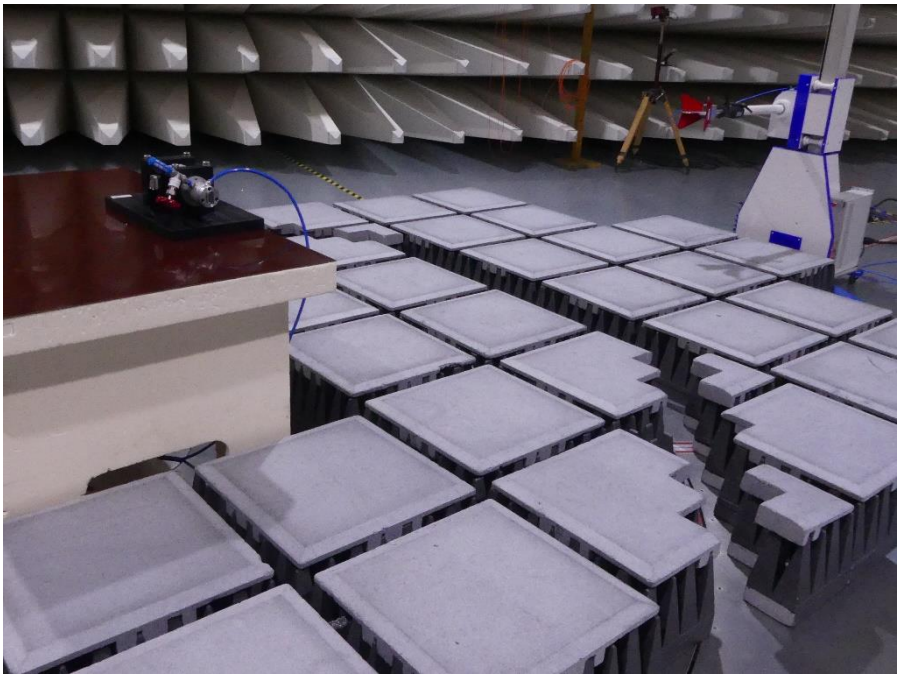


**Test setup up to 1 GHz vertical polarization**



| Test setup up to 1 GHz horizontal polarization |
| --- |
|  |

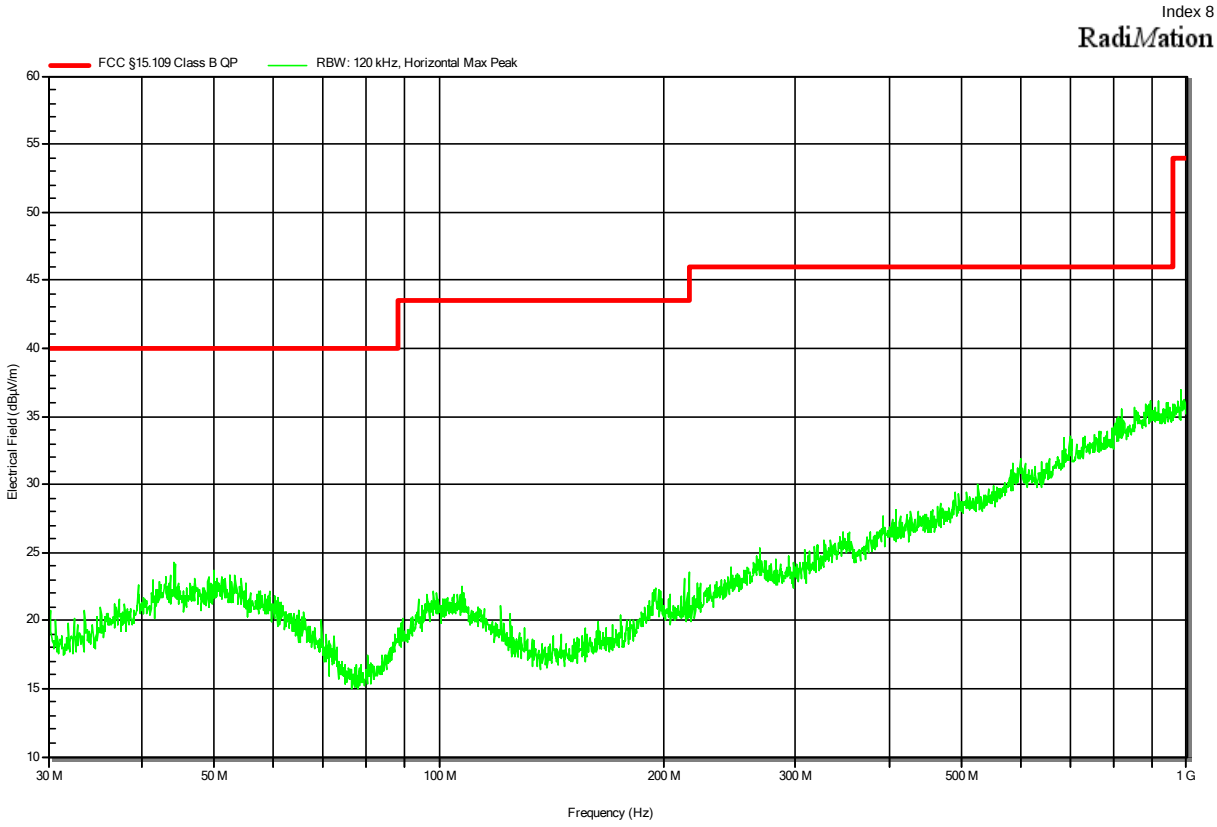
| Test setup above 1 GHz vertical polarization |
| --- |
|  |

| Test setup above 1 GHz horizontal polarization |
| --- |
|  |

2.1.8 Records

**Radiated emissions according to FCC 15B**

| | |
|---|---|
| Project Number: | G0M-2112-1232 |
| Applicant: | WTO Werkzeug-Einrichtungen GmbH |
| Model Description: | SDTH Controller |
| Model: | WTO SC 002 |
| Test Sample ID: | 39927 |
| Test Site: | Eurofins Product Service GmbH |
| Operator: | Mr. Engel |
| Test Date: | 2022-05-30 |
| Operating Conditions: | ambient temperature: 23 °Celsius<br>power input: Powered by Harvester |
| Antenna: | Schwarzbeck VULB 9162, Horizontal |
| Measurement Distance: | 10 m, converted to 3 m |
| Operational Mode: | Mode 1 |
| EUT Configuration: | Configuration 1 |
| Note 1: | Height 1 m, angle 0° |



**Radiated emissions**
**according to FCC 15B**

| | |
|---|---|
| Project Number: | G0M-2112-1232 |
| Applicant: | WTO Werkzeug-Einrichtungen GmbH |
| Model Description: | SDTH Controller |
| Model: | WTO SC 002 |
| Test Sample ID: | 39927 |
| Test Site: | Eurofins Product Service GmbH |
| Operator: | Mr. Engel |
| Test Date: | 2022-05-30 |
| Operating Conditions: | ambient temperature: 23 °Celsius<br>power input: Powered by Harvester |
| Antenna: | Schwarzbeck VULB 9162, Vertical |
| Measurement Distance: | 10 m, converted to 3 m |
| Operational Mode: | Mode 1 |
| EUT Configuration: | Configuration 1 |
| Note 1: | Height 1 m, angle 0° |

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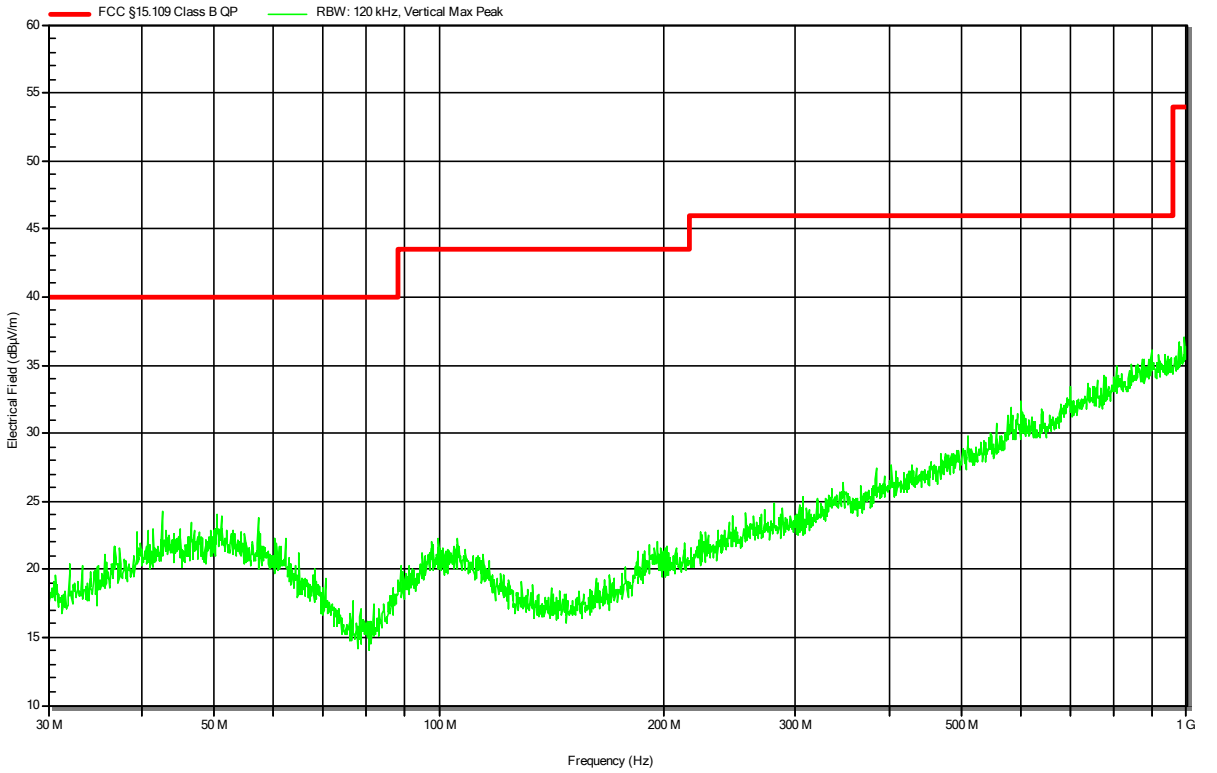
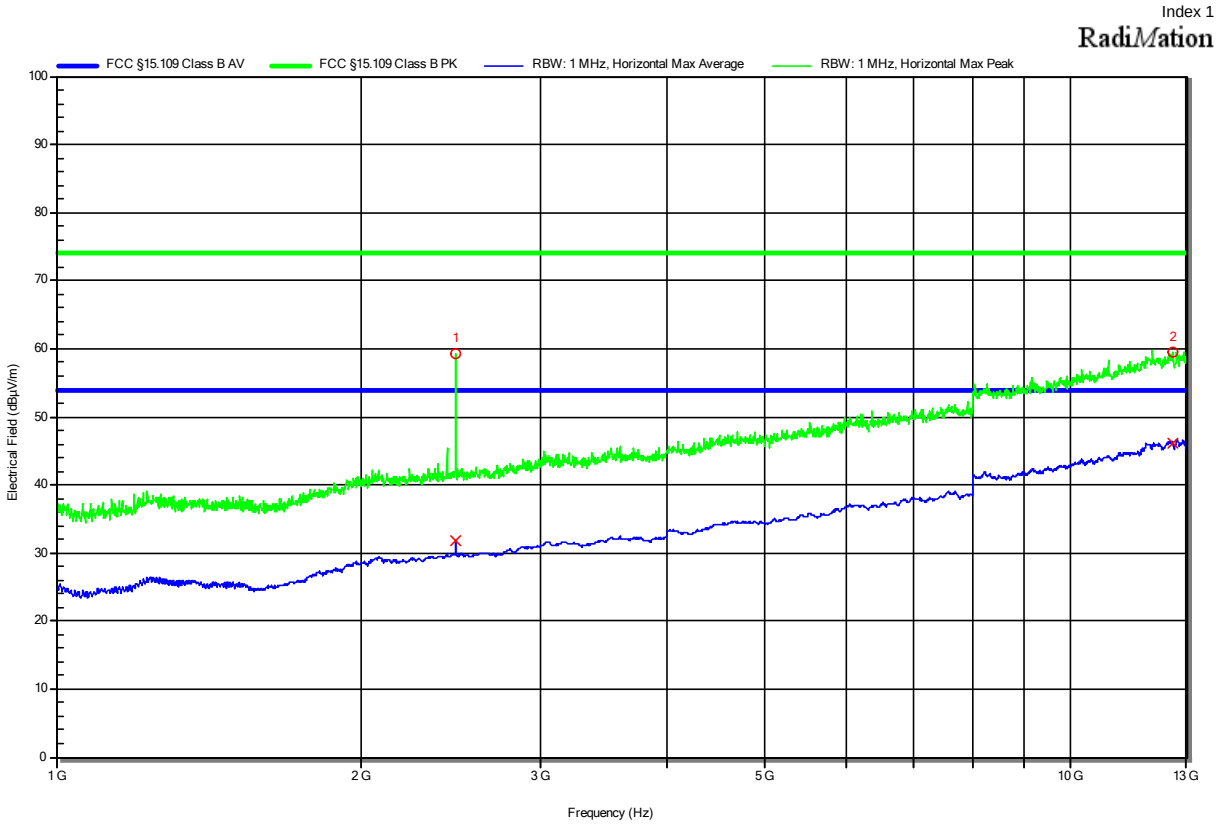
RadiMation



**Radiated emissions**
**according to FCC 15B**

| | |
|---|---|
| Project Number: | G0M-2112-1232 |
| Applicant: | WTO Werkzeug-Einrichtungen GmbH |
| Model Description: | SDTH Controller |
| Model: | WTO SC 002 |
| Test Sample ID: | 39927 |
| Test Site: | Eurofins Product Service GmbH |
| Operator: | Mr. Engel |
| Test Date: | 2022-05-30 |
| Operating Conditions: | ambient temperature: 23 °Celsius<br>power input: Powered by Harvester |
| Antenna: | ETS-Lindgren 3117, Horizontal |
| Measurement Distance: | 3 m |
| Operational Mode: | Mode 1 |
| EUT Configuration: | Configuration 1 |

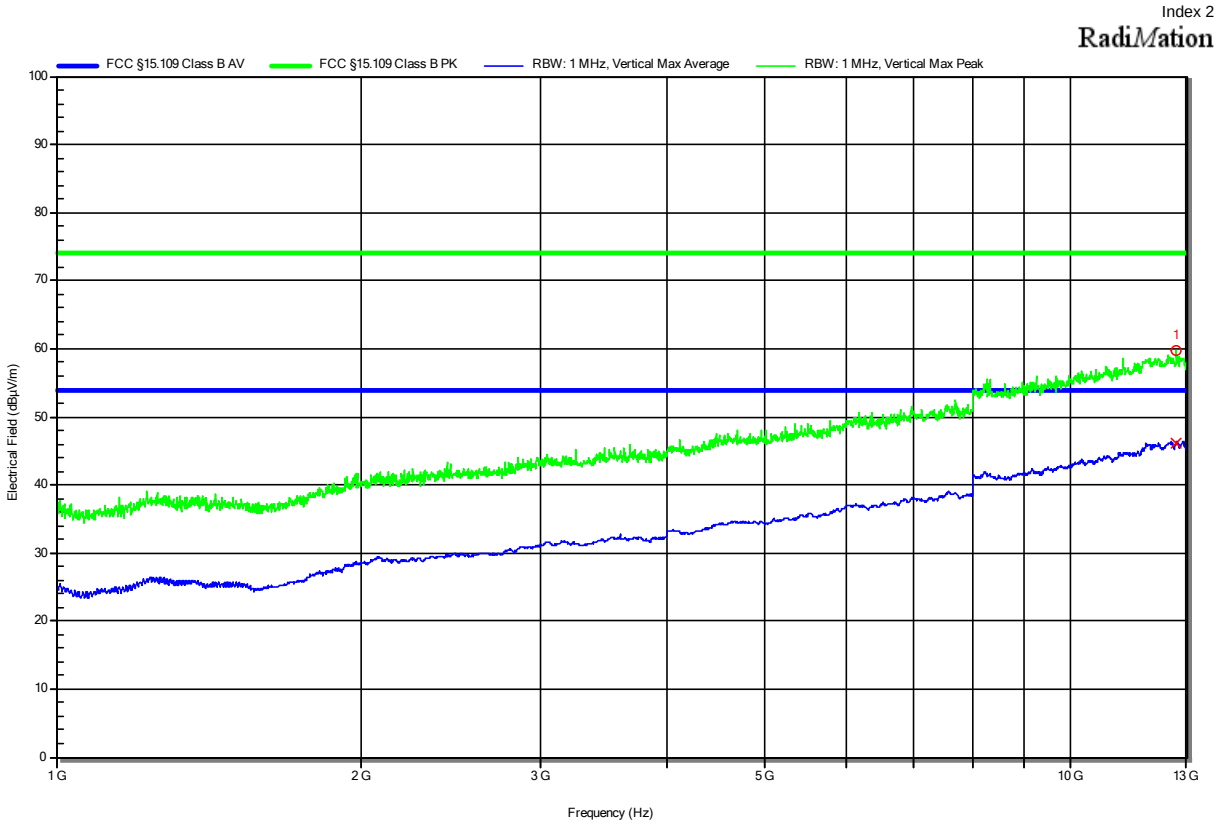



| Peak Number | Frequency | Peak | Peak Limit | Peak Difference | Peak Status | Angle | Height |
|---|---|---|---|---|---|---|---|
| 1 | 2.477 GHz | 59.4 dBµV/m | 74 dBµV/m | -14.6 dB | Carrier 2.4 GHz ISM band | | |
| 2 | 12.583 GHz | 59.5 dBµV/m | 74 dBµV/m | -14.4 dB | Pass | 0 degrees | 1 m |

| Peak Number | Frequency | Average | Average Limit | Average Difference | Average Status | Angle | Height |
|---|---|---|---|---|---|---|---|
| 1 | 2.477 GHz | 31.8 dBµV/m | 54 dBµV/m | -22.2 dB | Carrier 2.4 GHz ISM band | | |
| 2 | 12.583 GHz | 46.2 dBµV/m | 54 dBµV/m | -7.8 dB | Pass | 0 degrees | 1 m |

**Radiated emissions according to FCC 15B**

| | |
|---|---|
| Project Number: | G0M-2112-1232 |
| Applicant: | WTO Werkzeug-Einrichtungen GmbH |
| Model Description: | SDTH Controller |
| Model: | WTO SC 002 |
| Test Sample ID: | 39927 |
| Test Site: | Eurofins Product Service GmbH |
| Operator: | Mr. Engel |
| Test Date: | 2022-05-30 |
| Operating Conditions: | ambient temperature: 23 °Celsius<br>power input: Powered by Harvester |
| Antenna: | ETS-Lindgren 3117, Vertical |
| Measurement Distance: | 3 m |
| Operational Mode: | Mode 1 |
| EUT Configuration: | Configuration 1 |




| Peak Number | Frequency | Peak | Peak Limit | Peak Difference | Peak Status | Angle | Height |
|---|---|---|---|---|---|---|---|
| 1 | 12.694 GHz | 59.7 dBµV/m | 74 dBµV/m | -14.3 dB | Pass | 0 degrees | 1 m |

| Peak Number | Frequency | Average | Average Limit | Average Difference | Average Status | Angle | Height |
|---|---|---|---|---|---|---|---|
| 1 | 12.694 GHz | 46.1 dBµV/m | 54 dBµV/m | -7.9 dB | Pass | 0 degrees | 1 m |

# 3 Measurement Uncertainty

All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95%, with a coverage factor of 2.

| Test Name | Measurement Uncertainty |
|---|---|
| Radiated Emission | 30 MHz to 1 GHz @ 10 m, 6.25 dB<br>1 GHz to 6 GHz @ 3 m, 4.86 dB<br>6 GHz to 18 GHz @ 3 m, max. 5.39 dB |