




Test Report

Electromagnetic Compatibility

| | | | |
|--|--|--|---|
| Product | USB Camera | | |
| Name and address of the applicant | Huddly AS Karenslyst Allé 51 0279 Oslo, Norway | | |
| Name and address of the manufacturer | Huddly AS Karenslyst Allé 51 0279 Oslo, Norway | | |
| Model | H2-MBLK (Tested model, see page 4 for variants) | | |
| Rating | 900mA, 5V DC | | |
| Trademark |  | | |
| Serial number | B43F50028 | | |
| Additional information | Test plan document number HC-TPLN-0112 Rev. A0 released date: 19.07.2021, is submitted information for the EUT | | |
| Tested according to | EN 55032:2015 EN 55035:2017 FCC CFR 47 Subpart 15B ISED Canada ICES-003, Issue 7 | | |
| Order number | 445144 | | |
| Tested in period | 2021-07-20 to 2021-07-21 | | |
| Issue date | 2021-08-03 | | |
| Name and address of the testing laboratory | Nemko Group Nemko AS Philip Pedersens vei 11, 1366 Lysaker, Norway | TEL: +47 22 96 03 30 FAX: +47 22 96 05 50 |   |
| <small>An accredited technical test executed under the Norwegian accreditation scheme</small> | | | |
|  Prepared by [Tore Løvlien] | |  Approved by [Jan G Eriksen] | |
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REPORT REVISIONS

| Revision # | Date | Order # | Description |
|------------|------------|---------|--------------|
| 00 | 2021-08-03 | 445144 | First issued |
| | | | |
| | | | |



THIS REPORT APPLIES ONLY TO THE ITEM(S) AND CONFIGURATION(S) TESTED.

It is the manufacturer's responsibility to assure the additional production units of this product are manufactured with identical electrical and mechanical components. The manufacturer is responsible to the authorities for any modifications made to the product, which result in non-compliance to the relevant regulations.

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Opinions expressed within this report regarding general assessments and qualifications for PASS or FAIL to the standards limits and requirements, are not part of the current accreditation. Neither is opinions expressed regarding model variants covered by the testing performed in this report.

Deviations from, additions to, or exclusions from the test specifications are described in "Testing Report Summary".

DESCRIPTION OF TESTED ITEM(S)

| | |
|----------------------------|--|
| Product description..... : | The Huddly camera with Model IDs H1-MBLK, H2-MBLK , H2-MBLK-N, H2-STBL, H2- DRKR and H2-TGRY (H1 and H2), is a camera with smart features, for small to medium sized meeting rooms. H2 is the same hardware as H1, but with the addition of a microphone. The cameras are connected to a host computer using a USB-C cable. The host computer also powers the cameras through the cable. |
|----------------------------|--|

| | |
|-------------------------------|---|
| Model/type | H2-MBLK (tested model, see variants page 4) |
| Serial number | B43F50028 |
| Operating voltage..... | 5V |
| Maximum power/current..... | 900mA |
| Insulation class | III |
| Highest clock frequency | 5GHz |
| Hardware version | 830-00020-A0 |
| Software version | 1.4.22 |

| | |
|--------------------------|--|
| Mounting position..... : | <input checked="" type="checkbox"/> Table top equipment <input type="checkbox"/> Wall/ceiling mounted equipment <input type="checkbox"/> Floor standing equipment <input type="checkbox"/> Handheld equipment <input type="checkbox"/> Rack mounted equipment <input type="checkbox"/> Console equipment <input type="checkbox"/> Other: |
|--------------------------|--|

INPUT/OUTPUT PORTS

| Port name and description | Cable | | |
|---------------------------------|--------------------------|-------------------------------------|-------------------------------------|
| | Longer than 3m | Attached during test | Shielded |
| USB-C (DC and data) 0.6 m cable | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |

OPERATING MODES

| No. | Description | Applied for testing | |
|-----|-----------------------------|-------------------------------------|-------------------------------------|
| | | Emissions | Immunity |
| 1 | Video streaming to computer | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |

ACCESSORIES USED DURING TEST

| Description | Manufacturer | Type |
|-----------------|--------------|-------------|
| Laptop computer | Apple | Macbook Air |
| AC adapter | Apple | A2164 |

MODEL VARIANTS

The following model variants have been inspected and are confirmed to be identical or believed to be less disposed with regard to electromagnetic compatibility.

| Model/type | Comment | Tested |
|------------|---|-------------------------------------|
| H2-MBLK | - | <input checked="" type="checkbox"/> |
| H2-xxxx-y | xxxx denotes different colors, y denotes different software configurations) | <input type="checkbox"/> |
| H1-xxxx | (xxxx denotes different colors) | <input type="checkbox"/> |

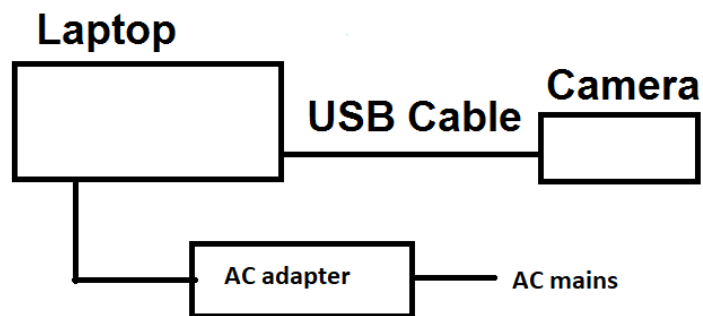
PHOTOS AND DRAWINGS

| | |
|-------------------------------------|--|
| <p>Copy of marking label..... :</p> |  |
|-------------------------------------|--|

Photo of the test item



Drawing of test setup




OTHER INFORMATION

| | |
|------------------------------|--|
| Modifications | None |
| Additional information | The camera was tested with 60cm USB-C cable to laptop MacBook Air model A2337 EMC 3598 Serial C02FCCYSQ6L5 |

Note: This equipment has been tested with certain cable types and cable configurations. Any changes to these parameters when installed may influence on the EMC properties of this equipment.

TEST ENVIRONMENT

| | |
|---------------------------------|--|
| Test laboratory | <input checked="" type="checkbox"/> KJELLER (Instituttveien 6, N-2007 Kjeller, Norway) <input type="checkbox"/> LYSAKER (Philip Pedersens vei 11, N-1366 Lysaker, Norway) |
| Laboratory accreditation |  Norsk Akkreditering – TEST 033 P06 – Electromagnetic Compatibility |
| Environmental conditions | <p>The climatic conditions during the tests are within limits specified by the manufacturer for the operation of the product and the test equipment.</p> <p>The climatic conditions during tests are within the following limits:</p> <p>Ambient temperature: 15 – 35 °C Relative humidity: 25 – 75 %RH Atmospheric pressure: 86 – 106 kPa</p> <p>If explicitly required by the test standard, or the requirements are tighter than the above; the climatic conditions are recorded and documented separately in this test report.</p> |
| Calibration | <p>All instruments used in the tests of this test report are calibrated and traceable to national or international standards. Between calibrations test set-ups are controlled and verified on a regular basis by intermediate checks to ensure, with 95% confidence that the instruments remain within their calibrated levels.</p> <p>The instrumentation accuracy is within limits agreed by the IECEE/CTL and defined by Nemko.</p> |
| Measurement uncertainties | <p>Uncertainty in EMC emission measurements stated in this report are calculated from the standard measurement uncertainties multiplied by the coverage factor k=2. It was determined in accordance with CISPR 16-4-2. The true value is in the corresponding interval with a probability of 95%.</p> <p>Uncertainties for continuous immunity tests are calculated based on the same principles as for EMC emission uncertainties.</p> <p>For Harmonics and Flicker measurements the measurement uncertainty is calculated based on the same principles as for EMC emission uncertainties.</p> <p>Uncertainties for transient immunity are kept within the requirements of the relevant basic standard.</p> <p><i>Further information about measurement uncertainties is provided on request.</i></p> |
| Decision rules | <p>As specified by CISPR 16-4-2; if our measurement uncertainty U_{LAB} is less than or equal to U_{CISPR}, compliance is deemed to occur if no measured disturbance level exceeds the limit hence “PASS” is indicated, and non-compliance is deemed to occur if any measured disturbance level exceeds the limits hence “FAIL” is indicated.</p> <p>For continuous immunity tests, uncertainties are not considered when applying the calibrated test levels. Tests are performed at the test levels specified by the test standard. PASS and FAIL decisions are based on behaviour observations of the specimen.</p> <p>For transient immunity tests, uncertainties are not considered if the test equipment is kept within the requirements of the relevant basic standard. Tests are performed at the test levels specified by the test standard. PASS and FAIL decisions are based on behaviour observations of the specimen.</p> <p>For Harmonics and Flicker measurements the measurement uncertainty is considered, and measurements are marked if necessary. In doing so, the associated uncertainty of measurement has been considered.</p> <p><i>Further information about decision rules is provided on request.</i></p> |

POWER SUPPLY CONDITIONS

The following nominal power supply conditions have been tested:

| PC no. | Voltage | Frequency | Type | Ground terminal |
|--------|---------|--|---|---|
| PC1 | 115 V | <input type="checkbox"/> AC 50Hz / <input checked="" type="checkbox"/> AC 60Hz / <input type="checkbox"/> DC | <input type="checkbox"/> 3AC / <input type="checkbox"/> 3ACN / <input type="checkbox"/> PoE | <input type="checkbox"/> PE / <input type="checkbox"/> GND / <input checked="" type="checkbox"/> None |
| PC2 | 5 V | <input type="checkbox"/> AC 50Hz / <input type="checkbox"/> AC 60Hz / <input checked="" type="checkbox"/> DC | <input type="checkbox"/> 3AC / <input type="checkbox"/> 3ACN / <input type="checkbox"/> PoE | <input type="checkbox"/> PE / <input type="checkbox"/> GND / <input checked="" type="checkbox"/> None |

- The power supply voltage has been selected after a maximum disturbance investigation over the product's rated voltage range.
- Additional chassis grounding was applied.

EVALUATION OF PERFORMANCE

PERFORMANCE TESTS

| | |
|---|---|
| Performance checks | Quality of the video stream |
| Performance tests | Quality of the video stream |
| Monitoring during tests | Visually monitoring of video stream on a laptop |
| <p>Note 1: Performance check is a short functional test carried out during or after a technical test to confirm that the equipment operates.</p> <p>Note 2: Performance test is a measurement, or a group of measurements carried out during and/or after a technical test to confirm that the equipment complies with selected parameters as defined in the equipment standard.</p> <p>Note 3: Monitoring during tests describes which functions were monitored and how.</p> | |

GENERAL PERFORMANCE CRITERIA

In order to pass each test, the specimen shall meet the following general criteria:

| During test | After test |
|--|--|
| Performance criterion A: Operate as intended. No loss of function. No unintentional responses. | Performance criterion A: Operate as intended. No loss of function. No degradation of performance. No loss of stored data or user programmable functions. |
| Performance criterion B: May be loss of function (one or more). No unintentional responses. | Performance criterion B: Operate as intended. Lost function(s) shall be self-recoverable. No degradation of performance. No loss of stored data or user programmable functions. |
| Performance criterion C: May be loss of function (one or more). | Performance criterion C: Lost function(s) shall be recoverable by the operator. Operate as intended after recovering. No degradation of performance. |

Note: In the subsequent test sections of this report, the required and actual specimen performance during immunity testing is indicated by the nomenclatures as given by the table above (A, B or C).

The following criteria shall be fulfilled when the H1 or H2 Camera is normally operating. These criteria would constitute the minimum acceptable performance level, (sometimes designated as Performance Criterion A).

Video resolution: The set video resolution shall persist and remain unaffected until manually changed.

Video image: The video image shall not: 1. show any obvious coincidental deficiencies due to applied disturbance. Deficiencies include, but is not limited to: • saturation of colors, • visible noise, • stripes (or similar) across the image, that does not belong there, • etc. 2. freeze 3. drop out or disconnect from the computer (i.e. video stream shall not to be lost)

Controls: The camera should also respond to the Huddly software installed on the computer.

TEST REPORT SUMMARY

APPLIED STANDARDS

| Standards | Titles |
|-------------------------------|--|
| EN 55032:2015 | <i>Electromagnetic compatibility of multimedia equipment - Emission requirements</i> |
| EN 55035:2017 | <i>Electromagnetic compatibility of multimedia equipment - Immunity requirements</i> |
| FCC CFR 47 Subpart 15B | <i>Digital devices - Unintentional radiators, Class B Digital Device</i> |
| ANSI C63.4:2014 | <i>Conducted emission testing, conducting ground plane, digital equipment, electric field measurement, line impedance stabilization network, low-voltage electrical equipment, low-voltage electronic equipment, magnetic field measurement, normalized site attenuation, radiated emission testing, radio-noise emissions, radio-noise power, site attenuation, unintentional radiators</i> |
| ISED Canada ICES-003, Issue 7 | <i>Spectrum Management and Telecommunications Policy. Interference-Causing Equipment Standard. Information Technology Equipment (Including Digital Apparatus - Limits and Methods of Measurement (Issue 6, June 2016)</i> |

TEST SUMMARY

| Requirements – Tests | Reference standards | Verdict |
|---|--|---------|
| Conducted Emissions | EN 55032:2015 FCC CFR 47 Subpart 15B ISED Canada ICES-003, Issue 7 ANSI C63.4:2014 CISPR 16-2-1:2017, Ed.3.1 | PASS |
| Conducted Emissions (Telecom Port) | EN 55032:2015 CISPR 16-2-1:2017, Ed.3.1 | N/A |
| Radiated Emissions (Below 1GHz) | EN 55032:2015 FCC CFR 47 Subpart 15B ISED Canada ICES-003, Issue 7 ANSI C63.4:2014 CISPR 16-2-3:2019, Ed.4.1 | PASS |
| Radiated Emissions (Above 1GHz) | EN 55032:2015 FCC CFR 47 Subpart 15B ISED Canada ICES-003, Issue 7 ANSI C63.4:2014 CISPR 16-2-3:2019, Ed.4.1 | PASS |
| Electrostatic Discharge (ESD) Immunity | EN 55035:2017 EN 61000-4-2:2009, Ed.2.0 | PASS |
| Radiated RF Disturbance Immunity | EN 55035:2017 EN 61000-4-3:2020, Ed.4.0 | PASS |
| Electric Fast Transients Immunity | EN 55035:2017 EN 61000-4-4:2012, Ed.3.0 | N/A |
| Surge Immunity | EN 55035:2017 EN 61000-4-5:2017, Ed.3.1 | N/A |
| Conducted RF Disturbance Immunity | EN 55035:2017 EN 61000-4-6:2014, Ed.4.0 | N/A |
| Power Frequency Magnetic Field Immunity | EN 55035:2017 EN 61000-4-8:2010, Ed.2.0 | N/A |
| Voltage Dips and Interruptions Immunity | EN 55035:2017 EN IEC 61000-4-11:2020, Ed.3.0 | N/A |

| | | |
|------|---|---|
| PASS | : | Tested and complied with the requirements |
| FAIL | : | Tested and failed the requirements |
| N/A | : | Test not relevant to this specimen (evaluated by the test laboratory) |
| – | : | Test not performed (instructed by the applicant) |
| * | : | An asterisk (*) placed after the verdict in the Result column indicates test items that are not within Nemko's scope of accreditation |
| # | : | A grid (#) placed after the verdict in the Result column indicates test items that are only partly covered by Nemko's scope of accreditation. Further information is detailed in the test section |

NOTES

Note 1: Product standards with dated references to basic standards may have been performed by Nemko AS according to the newest edition of the basic standard. This may impact the compliance criteria or technical performance of the test, still this is adequate as long as the test is expected to confirm compliance to the intention of the product standard. The table above lists the actual editions of the basic standards which have been used during testing.

Note 2: The choice of immunity test levels could be higher than those specified by the reference standards when we consider the nature of the specimen and its intended use or based on customer requests.

Test Results

CONDUCTED EMISSIONS

TEST DESCRIPTION

Method

The reference method for this test is listed in the table under clause TEST SUMMARY.

Set-up

The measurement was performed at the power supply terminal of the specimen. Nominal supply voltage was provided. The specimen was energized and in normal operating mode during the measurement.

- The specimen and its cables were elevated 10 cm above a ground plane.
- The specimen and its cables were elevated 40 cm above a ground plane.
- The specimen and its cables were placed 40 cm from a vertical ground plane, 80 cm over ground plane.
- The specimen was mounted directly on, and bonded to a ground plane. Cables and auxiliary equipment were elevated by 1 cm

- The specimen was connected to an Artificial Mains Network (AMN) by its power supply cable, which was adjusted to 100cm length by folding.
- The specimen was connected to an Artificial Mains Network (AMN) by a 0.8 m shielded power supply cable directly connected to the AMN

Conditions

- Frequency range was 9kHz – 30MHz.
- Frequency range was 10kHz – 30MHz.
- Frequency range was 150kHz – 30MHz.

The measuring bandwidth is 200Hz in the frequency range 9 kHz – 150 kHz. Measurement was made with a 100 Hz step size and 100 ms dwell time.

The measuring bandwidth is 9 kHz in the frequency range 150 kHz – 30 MHz. Measurement was made with a 4.5 kHz step size and 20 ms dwell time.

Measurement uncertainty: ± 3.7 dB (9 kHz – 150 kHz); ± 3.3 dB (150 kHz – 30 MHz)

Instruments used during measurement

Instrument list: AMN: R&S / ENV216 (LR-1665) (11/2021)
EMI Receiver: R&S / ESCI 3 (N-4259) (10/2021)

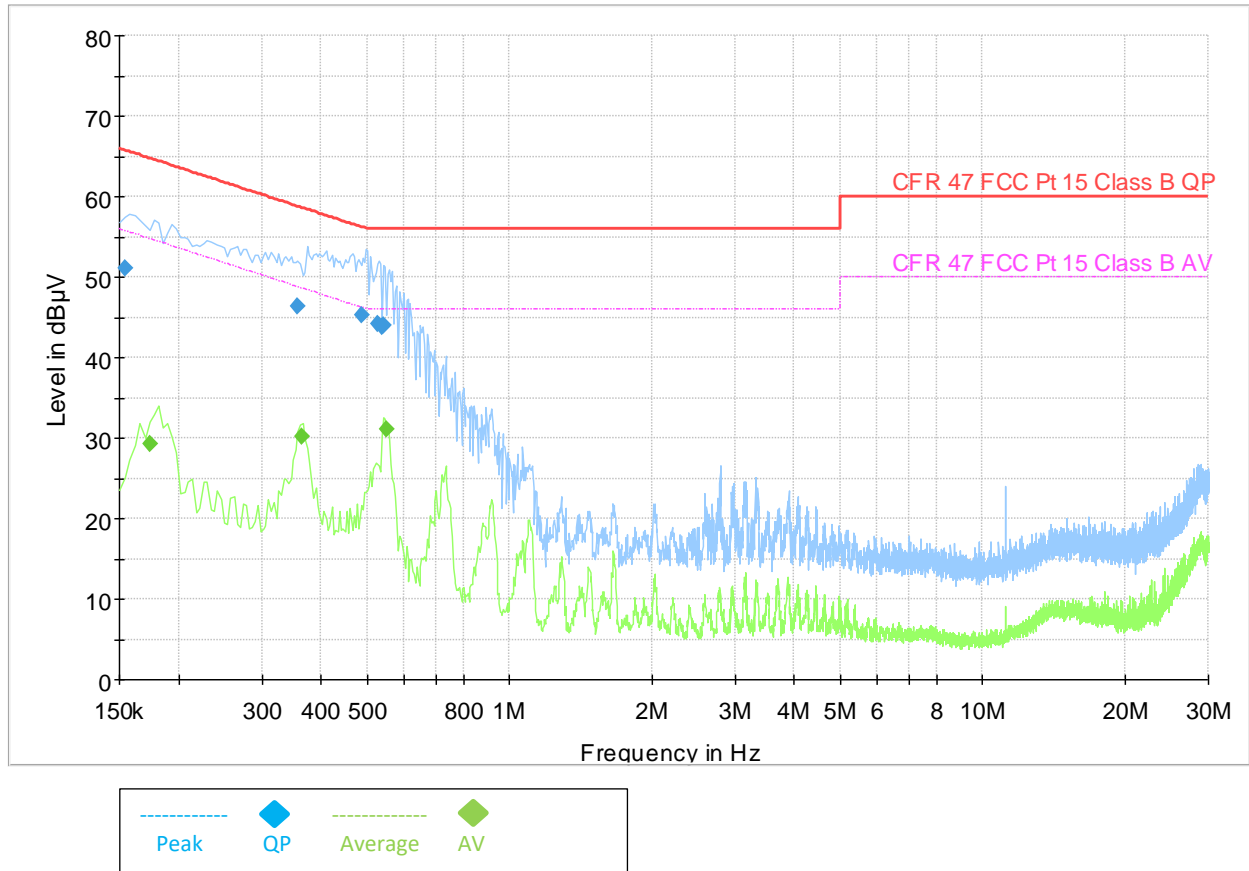
Conformity

Verdict: **PASS**

Test engineer: **TLO**

EMISSION SPECTRUM FCC 115V 60Hz

Full Spectrum



MEASUREMENT DATA

| Frequency (MHz) | QuasiPeak (dBµV) | Average (dBµV) | Limit (dBµV) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Line | Filter |
|-----------------|------------------|----------------|--------------|-------------|-----------------|-----------------|------|--------|
| 0.154 | 51.17 | --- | 65.78 | 14.61 | 1000 | 9 | N | OFF |
| 0.174 | --- | 29.22 | 54.77 | 25.55 | 1000 | 9 | L1 | OFF |
| 0.356 | 46.40 | --- | 58.82 | 12.42 | 1000 | 9 | L1 | OFF |
| 0.364 | --- | 30.27 | 48.64 | 18.37 | 1000 | 9 | L1 | OFF |
| 0.488 | 45.22 | --- | 56.20 | 10.98 | 1000 | 9 | L1 | OFF |
| 0.528 | 44.17 | --- | 56.00 | 11.83 | 1000 | 9 | L1 | OFF |
| 0.540 | 43.90 | --- | 56.00 | 12.10 | 1000 | 9 | N | OFF |
| 0.544 | 43.93 | --- | 56.00 | 12.07 | 1000 | 9 | L1 | OFF |
| 0.552 | --- | 31.04 | 46.00 | 14.96 | 1000 | 9 | L1 | OFF |

RADIATED EMISSIONS (BELOW 1GHZ)

TEST DESCRIPTION

Method

The reference method for this test is listed in the table under clause TEST SUMMARY.

Set-up

The measurements were performed in a semi-anechoic chamber (SAC). Nominal supply voltage was provided. The specimen was energized and in normal operating mode during the measurement.

- The specimen and its cables were elevated 10 cm above the site ground plane and placed in the centre of the turntable.
- The specimen and its cables were placed on a table 80 cm above the site ground plane and placed in the centre of the turntable.
- Ferrite clamps type CMAD were applied to cables leaving the test volume.
- A CDNE was applied to the power supply cable.

Antenna type = Hybrid bilog antenna

Antenna elevation = 100-400 cm above the ground reference plane.

Specimen rotation = 0-360°.

Frequency range:

- 30-300MHz
- 30-1000MHz
- Other:

Measurement distance:

- 3m (FCC)
- 5m
- 10m (EN55032)

Conditions

The measuring bandwidth is 120 kHz in the frequency range 30 MHz – 1000 MHz. Frequency sweeps with RBW = 120 kHz and VBW = 1 MHz was applied with a sweep time of 20 ms (step size resolution < 60 kHz).

Measurement uncertainty: ± 4.9 dB (3m distance in SAC10); ± 4.6 dB (3m distance in SAC3); ± 4.6 dB (10m distance in SAC10)

Instruments used during measurement

Instrument list: [Antenna, bilog: Sunol / JB3 \(N-4525\) \(02/2022\)](#)
 [EMI Receiver: R&S / ESU40 \(LR-1639\) \(02/2022\)](#)
 [Preamplifier: Sonoma / 310N \(LR-1686\) \(07/2021\)](#)

Conformity

Verdict:

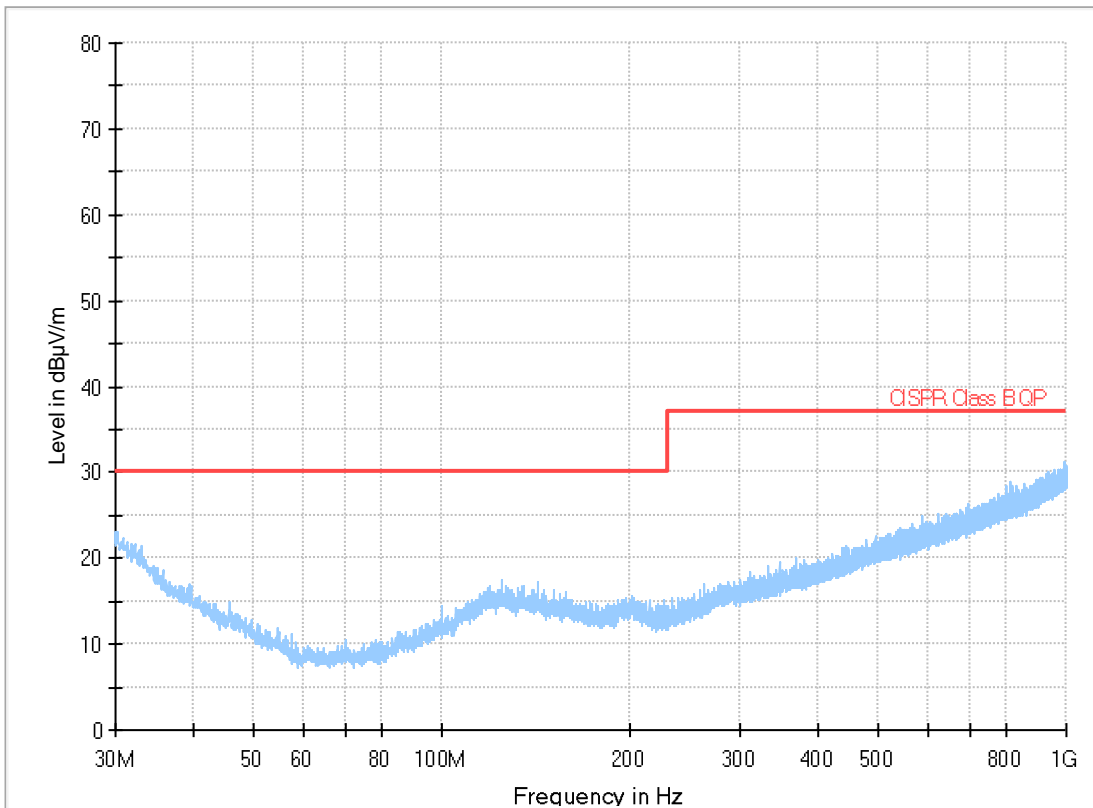
PASS

Test engineer:

TLO

EMISSION SPECTRUM EN55032

Full Spectrum



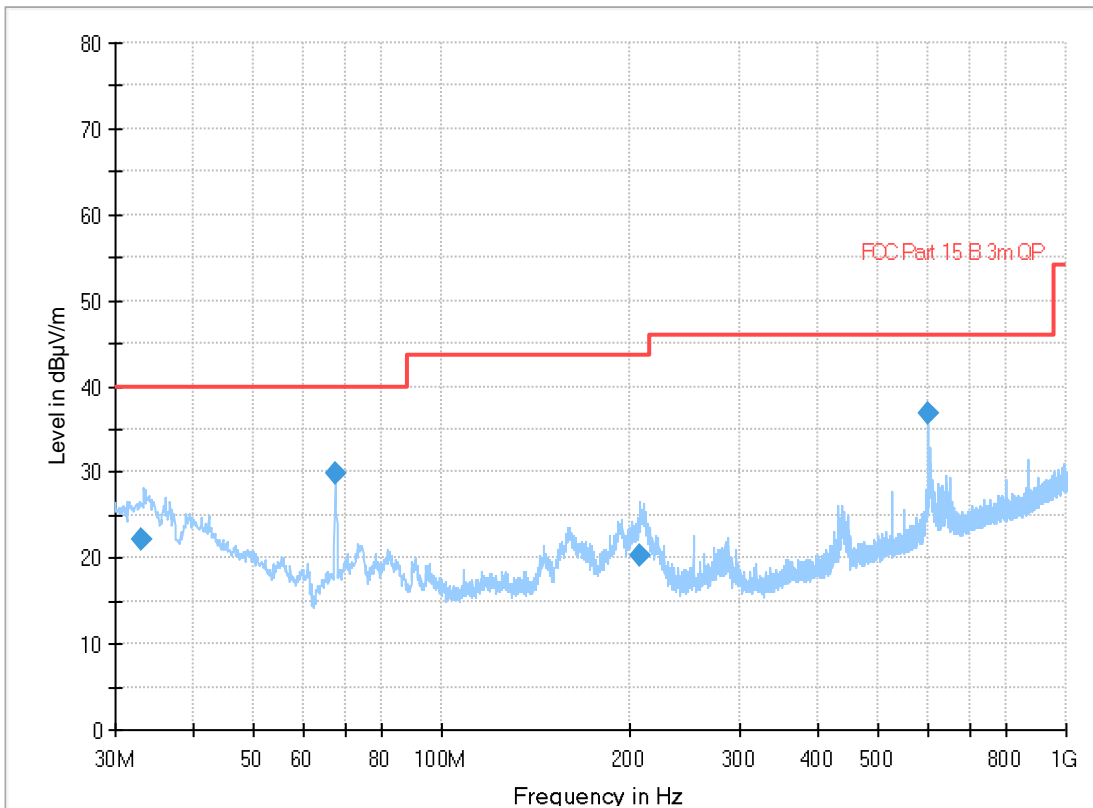
MEASUREMENTS DATA

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

(

EMISSION SPECTRUM FCC 115V 60Hz

Full Spectrum



MEASUREMENTS DATA

| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) |
|-----------------|--------------------|----------------|-------------|-----------------|-----------------|-------------|-----|---------------|
| 33.143200 | 22.09 | 40.00 | 17.91 | 1000.0 | 120.000 | 107.0 | V | 45.0 |
| 67.470450 | 29.79 | 40.00 | 10.21 | 1000.0 | 120.000 | 410.0 | H | 99.0 |
| 207.997950 | 20.24 | 43.50 | 23.26 | 1000.0 | 120.000 | 174.0 | H | 181.0 |
| 600.000750 | 36.94 | 46.00 | 9.06 | 1000.0 | 120.000 | 290.0 | H | 143.0 |

RADIATED EMISSIONS (ABOVE 1GHZ)

TEST DESCRIPTION

Method

The reference method for this test is listed in the table under clause TEST SUMMARY.

Set-up

Nominal supply voltage was provided. The specimen was energized and in normal operating mode during the measurement.

- The measurements were performed in a semi-anechoic chamber (SAC3) (calibrated volume: D=2.0m / H=2.0m).
- The measurements were performed in a semi-anechoic chamber (SAC10) (calibrated volume: D=1.5m / H=2.0m).
- The measurements were performed in a fully anechoic room (FAR) (calibrated volume: D=1.2m / H=2.0m).

- The specimen and its cables were elevated 10 cm above the site ground plane, and placed in the centre of the turntable.
- The specimen and its cables were placed on a table 80 cm above the site ground plane, and placed in the centre of the turntable.

The reference ground plane was covered with ferrite absorbers in the reflecting area between the specimen and the measuring antenna.

Measurement distance = 3m.

Antenna elevation = fixed at centre of specimen height.

Specimen rotation = 0-360°.

Measurements were performed with a double-ridged guide horn antenna.

Frequency range:

- 1-2 GHz
- 1-5 GHz
- 1-6 GHz (EN55032)
- 1-12 GHz (FCC)

Highest internal frequency of specimen:

- Below 108MHz
- Between 108MHz and 500MHz
- Between 500MHz and 1000MHz
- Above 1000MHz

The measuring bandwidth is 1 MHz in the above frequency range. Frequency sweeps with RBW = 1 MHz and VBW = 1 MHz was applied with a sweep time of 100 ms (proper segmentation of the frequency range was applied to obtain step size resolution < 500 kHz).

Measurement uncertainty: ± 5.1 dB

Instruments used during measurement

Instrument list: Antenna Horn: ETS / 3117 (LR-1717) (12/2021)
 EMI Receiver: R&S / ESU40 (LR-1639) (02/2022)
 Preamplifier: ETS / 3117-PA (LR-1757) (08/2021)

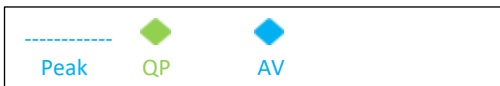
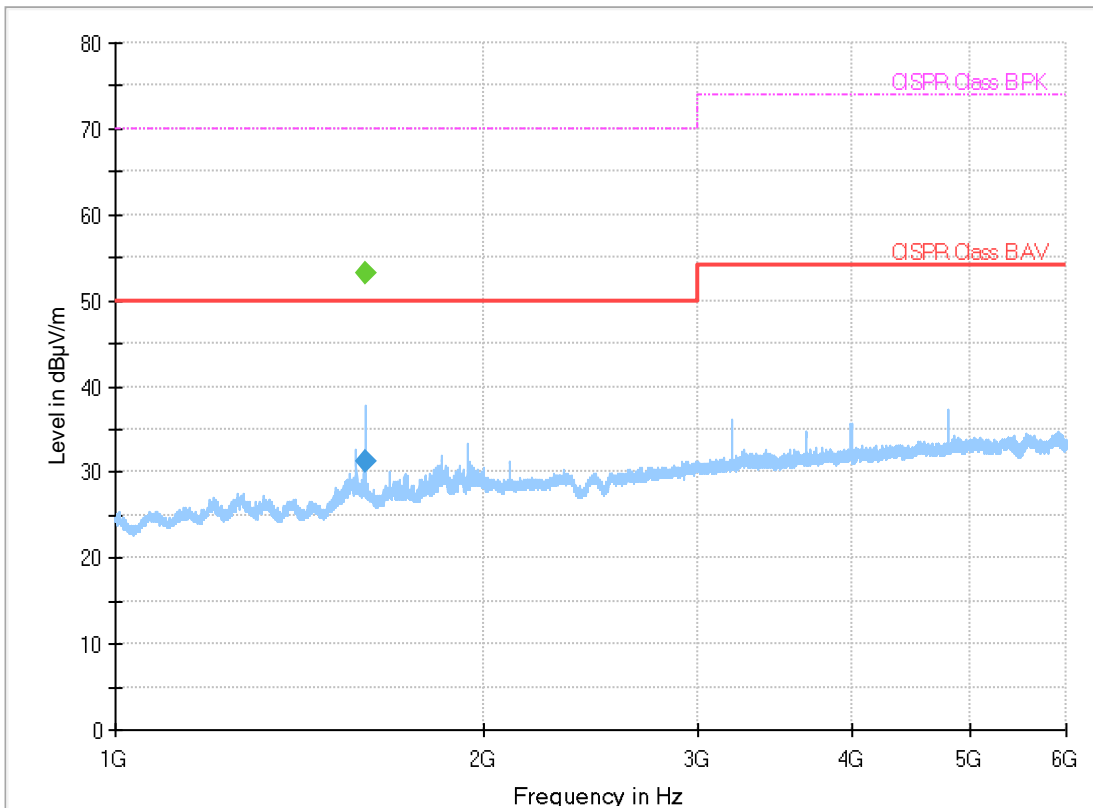
Conformity

Verdict: **PASS**

Test engineer: **TLO**

EMISSION SPECTRUM (HORIZONTAL POLARIZATION) EN55032

Full Spectrum

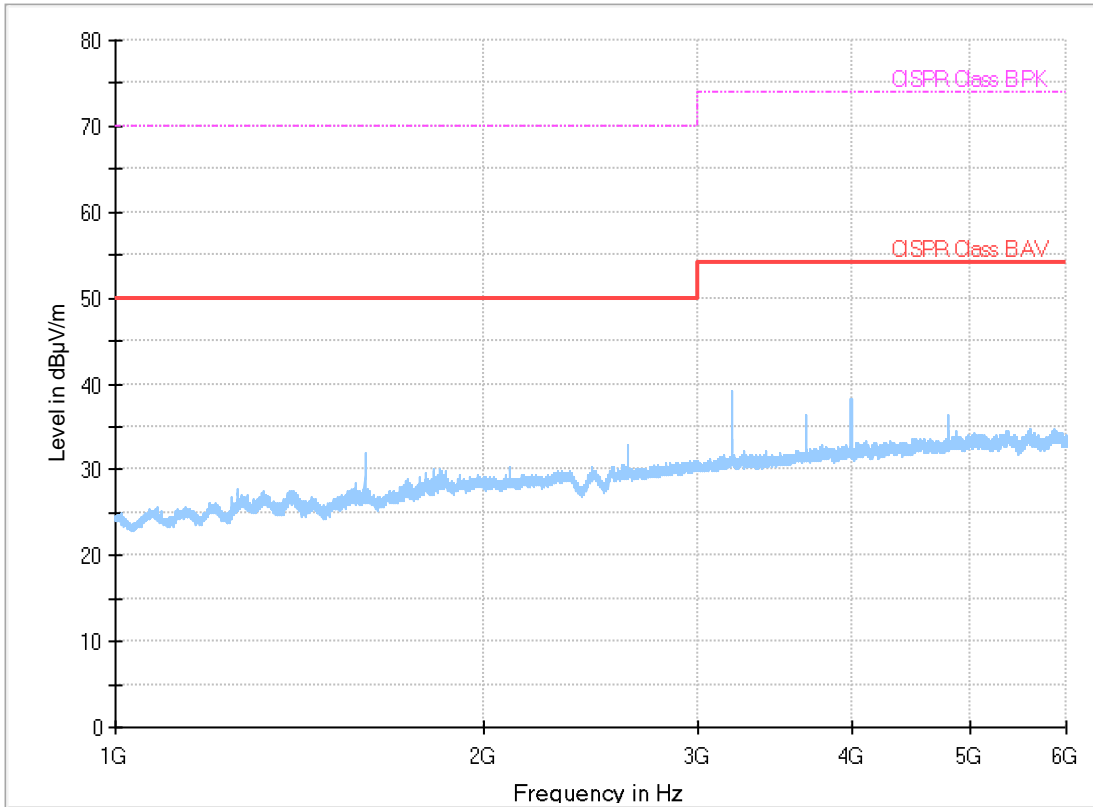


MEASUREMENTS DATA

| Frequency (MHz) | Average (dBµV/m) | MaxPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol |
|-----------------|------------------|------------------|----------------|-------------|-----------------|-----------------|-------------|-----|
| 1599.996000 | --- | 53.27 | 70.00 | 16.73 | 1000.0 | 1000.000 | 100.0 | H |
| 1599.996000 | 31.23 | --- | 50.00 | 18.77 | 1000.0 | 1000.000 | 100.0 | H |

EMISSION SPECTRUM (VERTICAL POLARIZATION) EN55032

Full Spectrum



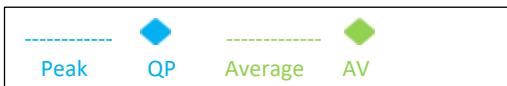
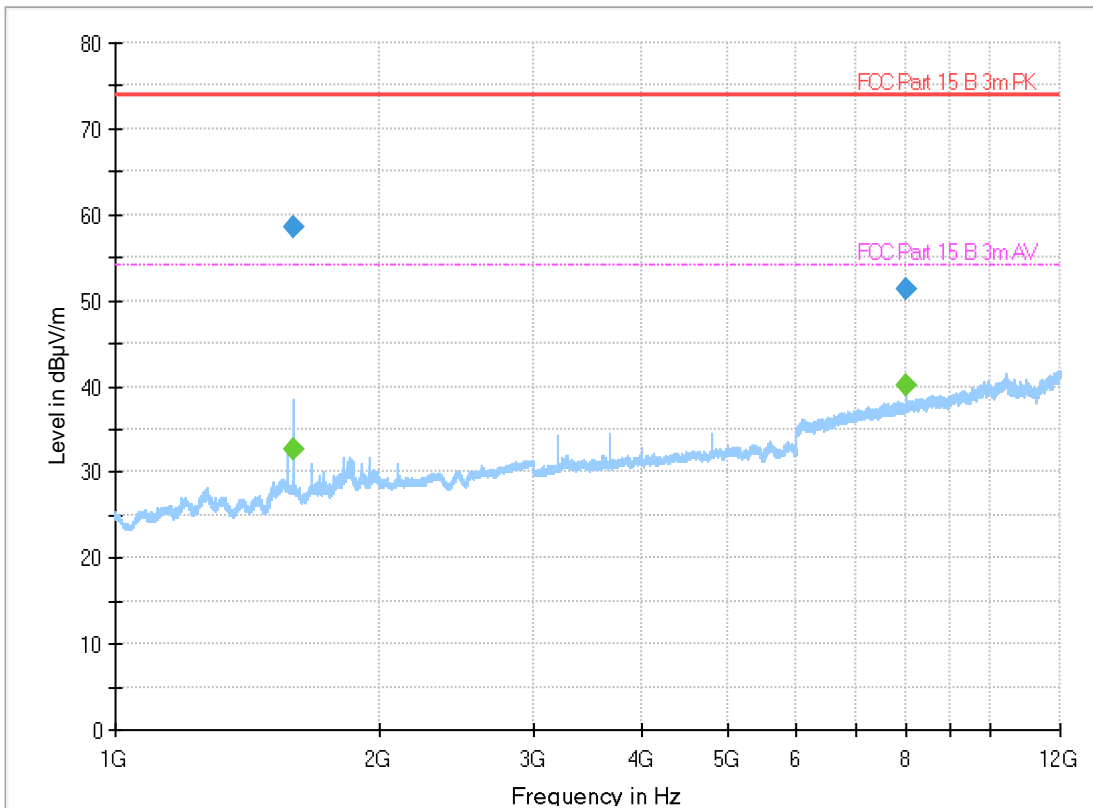
Peak

MEASUREMENTS DATA

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

EMISSION SPECTRUM (HORIZONTAL POLARIZATION) FCC

Full Spectrum

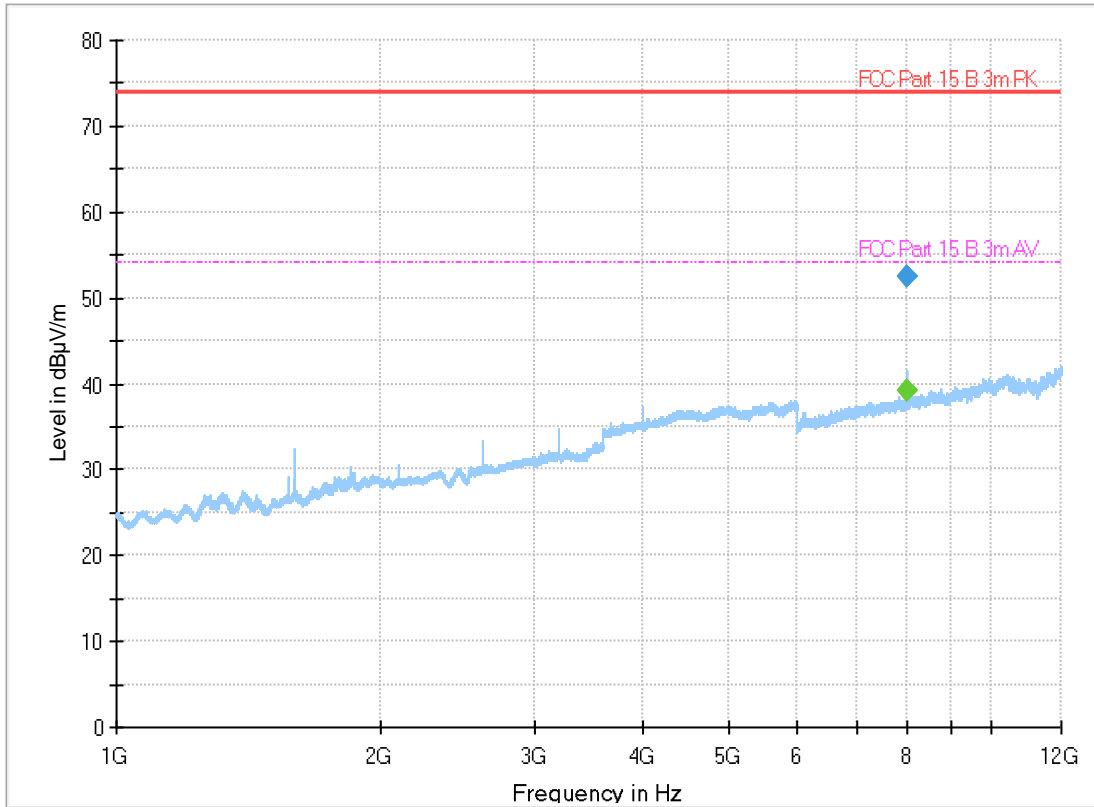


MEASUREMENTS DATA

| Frequency (MHz) | MaxPeak (dBµV/m) | Average (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol |
|-----------------|------------------|------------------|----------------|-------------|-----------------|-----------------|-------------|-----|
| 1599.992000 | --- | 32.72 | 54.00 | 21.28 | 1000.0 | 1000.000 | 100.0 | H |
| 1599.992000 | 58.57 | --- | 74.00 | 15.43 | 1000.0 | 1000.000 | 100.0 | H |
| 7999.994333 | --- | 40.11 | 54.00 | 13.89 | 1000.0 | 1000.000 | 100.0 | H |
| 7999.994333 | 51.37 | --- | 74.00 | 22.63 | 1000.0 | 1000.000 | 100.0 | H |

EMISSION SPECTRUM (VERTICAL POLARIZATION) FCC

Full Spectrum



MEASUREMENTS DATA

| Frequency (MHz) | MaxPeak (dBµV/m) | Average (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol |
|-----------------|------------------|------------------|----------------|-------------|-----------------|-----------------|-------------|-----|
| 8000.003667 | --- | 39.16 | 54.00 | 14.84 | 1000.0 | 1000.000 | 100.0 | V |
| 8000.003667 | 52.48 | --- | 74.00 | 21.52 | 1000.0 | 1000.000 | 100.0 | V |

ELECTROSTATIC DISCHARGE (ESD) IMMUNITY

TEST DESCRIPTION

Method

The reference method for this test is listed in the table under clause TEST SUMMARY.

Set-up

The specimen was energized and in normal operating condition.

- Floor standing equipment. Specimen was elevated 10 cm above the ground reference plane.
- Tabletop equipment. Specimen was placed on a test table 80 cm above the reference ground plane.
A horizontal coupling plane (HCP) of 160x80 cm was placed on the test table, just beneath the specimen, and connected to the reference plane via a cable with two 470k Ω resistors located one in each end of the cable. The specimen was separated from the HCP by a 0.5mm insulating support.

A vertical coupling plane (VCP) of 50x50 cm was placed 10 cm from the specimen exterior. This VCP is connected to the reference plane via a cable with two 470k Ω resistors located one in each end of the cable.

The ESD generator's reference ground was connected to the reference ground plane.

Procedure

- Indirect contact discharges were applied to the mid edge of the VCP.
- Indirect contact discharges were applied to the mid edge of the HCP.
- Direct contact discharges were applied to various selected test points of the specimen at conductive surfaces,
- Direct air discharges were applied to various selected test points of the specimen at non-conductive surfaces.

Discharges were applied at increasing levels to each test point.

Uncertainty figures: Peak voltage: $\pm 10\%$; Transient shape: $\pm 30\%$

A functional test was performed before and after the exposure. The specimen was observed during exposure in order to detect unintended responses.

Instruments used during measurement

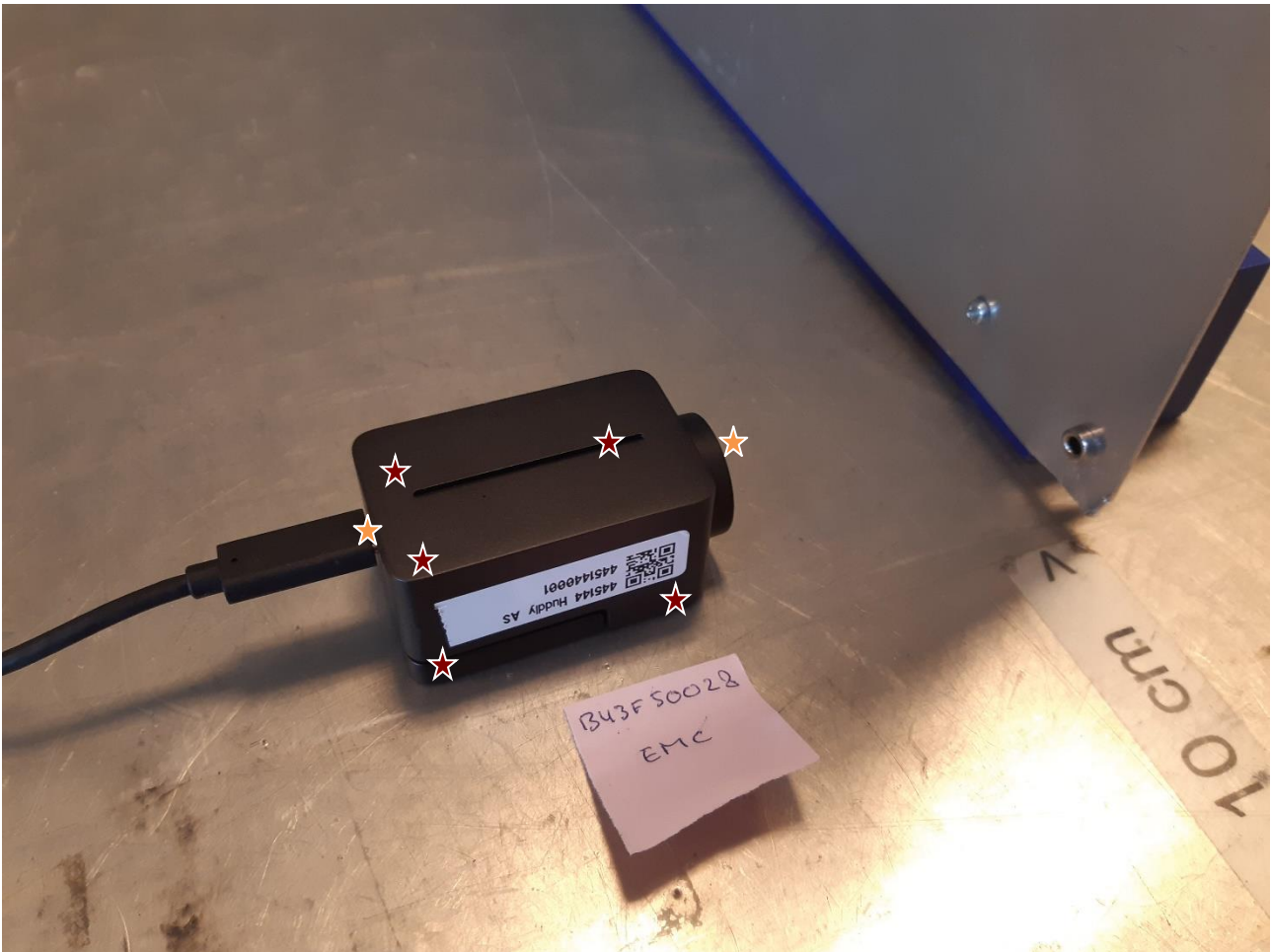
Instrument list: [ESD Generator: EMTest / Dito \(LR-1733\) \(08/2021\)](#)

| | |
|------------------|----------|
| Temperature: | 22 °C |
| Humidity: | 47 %RH |
| Atmos. pressure: | 1019 hPA |

Conformity

| | |
|----------------|------|
| Verdict: | PASS |
| Test engineer: | TLO |

PHOTO OF SELECTED TEST POINTS



- ★ = Contact discharge points
- ★ = Air discharge points

DETAILED TEST LOG

| Test Point | Applied Level [kV] | Discharge Type | Discharges per test level | Required Criteria | Complied Criteria | Result |
|--------------------------|--------------------|----------------|---------------------------|-------------------|-------------------|--------|
| Lens and led | ±4, ±8 | Air | 10 | B | A | PASS |
| Cable connector | ±4, ±8 | Air | 10 | B | A | PASS |
| Metal parts of enclosure | ±2, ±4 | Contact | 10 | B | A | PASS |
| HCP | ±2, ±4 | Contact | 10 | B | A | PASS |
| VCP | ±2, ±4 | Contact | 10 | B | A | PASS |

Note: ND = No Discharge, indicates discharge attempts, which have given no actual observable discharge.

OBSERVATIONS

No malfunctions were recorded during or after the applied test(s).
 Observations showed no unintended responses during test(s).

RADIATED RF DISTURBANCE IMMUNITY

TEST DESCRIPTION

Method

The reference method for this test is listed in the table under clause TEST SUMMARY.

Set-up

The tests were performed at 3 meter antenna distance in an anechoic chamber.

- The specimen was placed on a Styrofoam support 10 cm above the floor.
- The specimen was placed on a Styrodur/styrofoam table 80 cm above the floor.

The specimen was placed within the calibrated volume, and the cables connected to the specimen was arranged so that 100 cm of each cable was exposed to the electromagnetic field.

Interconnecting cables specified ≤ 300 cm whose length exceeded 100 cm were bundled to achieve 100 cm length.

Interconnecting cables specified > 300 cm and other cables connected to the specimen are exposed for 100 cm, and the remaining cable length was decoupled with the use of ferrites.

Procedure

The specimen was exposed to the RF electromagnetic field generated by one or more antennas. The polarization of the field requires testing each side of the specimen twice, once with the antenna horizontally and again with the antenna vertically. The antenna height during test was 150 cm.

Exposed side of the specimen:

- 0° (front) Top (handheld)
- 90° Bottom (handheld)
- 180° (rear)
- 270°

Frequency sweep rate:

- 1% step with 3 sec dwell time
- 1.5×10^{-3} decades/sec (80 – 1000MHz)
- 0.5×10^{-3} decades/sec (1000 – 2000MHz)
- Other:

Frequency range:

- 80MHz – 1000MHz
- 1400MHz – 2000MHz
- 2000MHz – 2700MHz
- 80MHz – 2000MHz
- 80MHz – 6000MHz

Modulation:

- 80% AM @ 1000Hz
- 80% AM @ 400Hz
- 50% PM @ 217Hz

Uncertainty figures:

Field level: ± 2.4 dB

A functional test was performed before and after the exposure. The specimen was observed during exposure in order to detect unintended responses.

Instruments used during measurement

Instrument list: Amplifier, GF: AR / 120S1G4M3 (LR-1595) (N/A)
 Amplifier, RF: AR / 500W1000A (LR-1354) (N/A)
 Antenna Log-periodic: R&S / HL 023A1 (LR-0282) (N/A)
 Generator, RF: R&S / SMB100A (LR-1603) (10/2023)
 Power Meter: R&S / NRVD (LR-1347) (05/2021)
 Power Sensor: R&S / NRV-Z5 (LR-1372) (05/2021)

Conformity

| | |
|----------------|-------------|
| Verdict: | PASS |
| Test engineer: | TLO |

DETAILED TEST LOG

| Frequency range [MHz] | Field strength [V/m] | Polarization | Required Criteria | Complied Criteria | Result |
|-----------------------|----------------------|--------------|-------------------|-------------------|--------|
| 80 - 6000 | 3 | HOR | A | A | PASS |
| 80 - 6000 | 3 | VER | A | A | PASS |

Additional tests were performed at discrete spot frequencies with 3V/m test level. Spot frequencies which were tested: 80 MHz, 120 MHz, 160 MHz, 230 MHz, 434 MHz, 460 MHz, 600 MHz, 863 MHz, 900 MHz, 1800 MHz, 2600 MHz, 3500 MHz, and 5000 MHz

OBSERVATIONS

No malfunctions were recorded during or after the applied test(s).
Observations showed no unintended responses during test(s).

Annexes

PHOTOS

Test set-up for EMC emissions measurements



Conducted emission



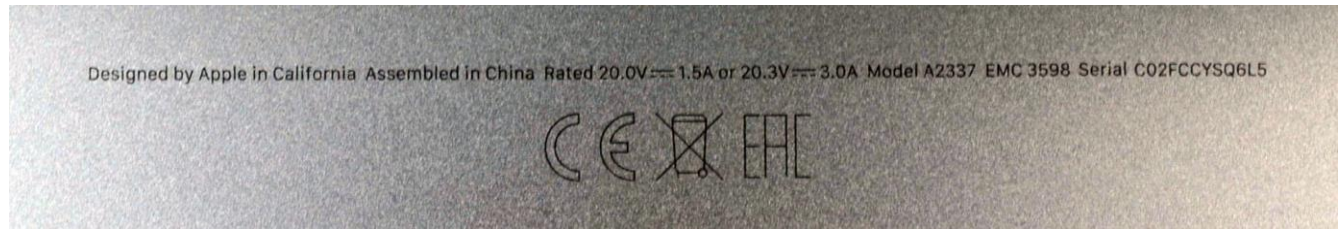
Radiated emission

Test set-up for EMC immunity tests



Radiated RF Immunity

Test set-up for FCC measured with AC/DC adapter model A2164 and laptop MacBook Air model A2337 EMC 3598 Serial C02FCCYSQ6L5



Designed by Apple in California Assembled in China Rated 20.0V $\overline{=}$ 1.5A or 20.3V $\overline{=}$ 3.0A Model A2337 EMC 3598 Serial C02FCCYSQ6L5

