

Test Report

Electromagnetic Compatibility

Product	ultraBeacon Single-Zone		
Name and address of the applicant	Sonitor Technologies AS Drammensveien 288 0283 Oslo, Norway		
Name and address of the manufacturer	Sonitor Technologies AS Drammensveien 288 0283 Oslo, Norway		
Model	INF-C361/INF-C371		
Rating	3.7 - 7.3 V DC (DC or battery powered)		
Trademark			
Additional information	Bluetooth Low Energy and IEEE 802.15.4 (Snobee).		
Tested according to	ETSI EN 301 489-01 V2.2.3 ETSI EN 301 489-17 V3.2.4 EN 55032:2015 + AC:2016 + A11:2020 FCC CFR 47 Subpart 15B ISED Canada ICES-003, Issue 7 New Zealand Gazette, No.2023-go4026		
Project number	PRJ0036884		
Tested in period	2024-01-29 to 2024-02-02		
Issue date	2024-02-29		
Name and address of the testing laboratory	Nemko Scandinavia AS Instituttveien 6, 2007 Kjeller, Norway		
An accredited technical test executed under the Norwegian accreditation scheme			
 Prepared by [Tore Løvlien]		 Approved by [Roger Berget]	

Nemko Group

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REPORT REVISIONS

Report Edition	Date	Project	Description
A	2024-02-29	PRJ0036884	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 "Test Report Summary".

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DESCRIPTION OF TESTED ITEM(S)

Product description..... :	The device is a transmitter of ultrasound with a BLE/802.15.4 radio transceiver chip. The device is an infrastructure unit in Sonitor solutions for indoor location services. The ultrasound is used to communicate USIDs to locatables, like tags. The radio functionality is BLE for signal beaconing and BLE or 802.15.4 for backhaul communication. The device is manufactured in two versions, with batteries vs. a DC voltage selection, or with batteries vs. a POE selection. See REP026865 for testing of POE-variant. The two versions have identical design and BOM, but the population of components on the board will deviate slightly to accommodate the two different powering options. Snobee is based upon IEEE 802.15.4.
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Model/type	INF-C361
Serial number	00000035
Operating voltage..... :	6 V DC (DC or battery powered)
Maximum power/current..... :	/
Insulation class	II
Highest clock frequency	2400 MHz
Hardware version	1.3
Software version	/

Model/type	INF-C371
Serial number	00000035
Operating voltage..... :	6 V DC (DC or battery powered)
Maximum power/current..... :	/
Insulation class	II
Highest clock frequency	2400 MHz
Hardware version	1.3
Software version	/

Mounting position..... :	<input type="checkbox"/> Tabletop equipment <input checked="" 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:
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RF CHARACTERISTICS OF THE TRANSMITTER

Type	BLE	IEEE 802.15.4 (Snobee)
Frequency range.....	2.402-2.480 GHz	2.405-2.480 GHz
Number of channels.....	40	16
Channel BW	1 MHz	5 MHz
Rated output power	8 dBm	8 dBm
Receiver category.....	2	2
Classification	/	/
Operating modes.....	Transceiver	Transceiver
Types of modulation	GFSK	Offset-QPSK
Tunable bands	/	/
User frequency adjustment.....	/	/
Antenna type.....	/	/
Antenna gain	/	/
Antenna connection.....	Integral	Integral
Number of antennas	1	1
Antenna diversity/MIMO	/	/

ACCESSORIES USED DURING TEST

Description	Manufacturer	Type
AC adapter	Clas Ohlson	0055
Laptop	Dell	/

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	Description of differences	Tested
INF-C361	Snobee controlled, DC/battery operated	<input type="checkbox"/>
INF-C371	BLE controlled, HW identical to the above	<input checked="" type="checkbox"/>

The two variants both have the same radio hardware and can be set to use Snobee or BLE as required. Thus, all EMC tests have been performed using only the BLE. Given the low transmitted power (less than 10 dBm) it is highly probable that the chosen modulation has no effect on the test result – neither for radiated emission nor immunity tests.

INPUT/OUTPUT PORTS

Port name and description	Cable		
	Longer than 3m	Attached during test	Shielded
DC Input port	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
AC Mains	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

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

OPERATING MODES

OP no.	Description	Applied for testing	
		Emissions	Immunity
OP1	BLE DC	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
OP2	BLE Batteries	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

POWER SUPPLY CONDITIONS

The following nominal power supply conditions have been tested:

PC no.	Voltage	Frequency	Type	Ground terminal
PC1	6 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
PC1	120 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

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


PHOTOS AND DRAWINGS

Photo of the test item	
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OTHER INFORMATION

Modifications	None
Additional information	None

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	 <p>Norsk Akkreditering – TEST 033 P06 – Electromagnetic Compatibility</p>
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. 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. 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%. Uncertainties for continuous immunity tests are calculated based on the same principles as for EMC emission uncertainties. For Harmonics and Flicker measurements the measurement uncertainty is calculated based on the same principles as for EMC emission uncertainties. Uncertainties for transient immunity are kept within the requirements of the relevant basic standard. <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. 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. 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. 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. <i>Further information about decision rules is provided on request.</i></p>

EVALUATION OF PERFORMANCE

PERFORMANCE TESTS

Performance checks	Communication to a laptop
Performance tests	Not loose communication to BLE and ultrasound 40 kHz
Monitoring during tests	Communication is monitored by client's software on a laptop
<p>Information:</p> <p>Performance check is a short functional test carried out during or after a technical test to confirm that the equipment operates.</p> <p>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>Monitoring during tests describes which functions were monitored and how.</p>	

GENERAL PERFORMANCE CRITERIA

For the specimen to pass each test, it shall meet the following general criteria:

During test	After test
<p>Performance criterion A: Operate as intended. No loss of function. No unintentional responses.</p>	<p>Performance criterion A: Operate as intended. No loss of function. No degradation of performance. No loss of stored data or user programmable functions.</p>
<p>Performance criterion B: May be loss of function (one or more). No unintentional responses.</p>	<p>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.</p>
<p>Performance criterion C: May be loss of function (one or more).</p>	<p>Performance criterion C: Lost function(s) shall be recoverable by the operator. Operate as intended after recovering. No degradation of performance.</p>
<p>Information:</p> <p>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, CT, TT, CR or TR).</p>	

TRANSMITTER PERFORMANCE CRITERIA

For the specimen to pass each test, the transmitter functions shall meet the following criteria:

During continuous tests	During transient tests
<p>Performance criterion CT: During and after the test, the apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed below a permissible performance level specified by the manufacturer when the apparatus is used as intended. In some cases this permissible performance level may be replaced by a permissible loss of performance. During the test the EUT shall not unintentionally transmit or change its actual operating state and stored data. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be deduced from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.</p>	<p>Performance criterion TT: After the test, the apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed below a permissible performance level specified by the manufacturer, when the apparatus is used as intended. In some cases this permissible performance level may be replaced by a permissible loss of performance. During the EMC exposure to an electromagnetic phenomenon, a degradation of performance is, however, allowed. No change of the actual mode of operation (e.g. unintended transmission) or stored data is allowed. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be deduced from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.</p>
<p>Modification by the manufacturer: Not modified</p>	<p>Modification by the manufacturer: Not modified</p>
<p>Information: 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 (CT, TT).</p>	

RECEIVER PERFORMANCE CRITERIA

For the specimen to pass each test, the receiver functions shall meet the following criteria:

During continuous tests	During transient tests
<p>Performance criterion CR : During and after the test, the apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed below a permissible performance level specified by the manufacturer when the apparatus is used as intended. In some cases this permissible performance level may be replaced by a permissible loss of performance. During the test the EUT shall not unintentionally transmit or change its actual operating state and stored data. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be deduced from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.</p>	<p>Performance criterion TR : After the test, the apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed below a permissible performance level specified by the manufacturer, when the apparatus is used as intended. In some cases this permissible performance level may be replaced by a permissible loss of performance. During the EMC exposure to an electromagnetic phenomenon, a degradation of performance is, however, allowed. No change of the actual mode of operation (e.g. unintended transmission) or stored data is allowed. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be deduced from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.</p>
<p>Modification by the manufacturer: Not modified</p>	<p>Modification by the manufacturer: Not modified</p>
<p>Information: 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 (CR or TR).</p>	

TEST REPORT SUMMARY

APPLIED STANDARDS

Standards	Titles
ETSI EN 301 489-01 V2.2.3	<i>Electromagnetic compatibility and Radio spectrum Matters (ERM); Electromagnetic compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements</i>
ETSI EN 301 489-17 V3.2.4	<i>Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 17: Specific conditions for Broadband Data transmission systems</i>
EN 55032:2015 + AC:2016 + A11:2020	<i>Electromagnetic compatibility of multimedia equipment - Emission requirements</i>
FCC CFR 47 Subpart 15B	<i>Digital devices - Unintentional radiators, Class B Digital Device</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 7, June 2020)</i>
New Zealand Gazette, No.2023-go4026 *	<i>Radiocommunications Regulations (Radio Standards) Notice 2023, Table 2</i>

* : An asterisk (*) placed after the standard name indicates standards that are not within the laboratory scope of accreditation.

TEST SUMMARY

Requirements – Tests	Reference standards	Verdict
Conducted Emissions (Method: CISPR 16-2-1:2017, Ed.3.1)	ETSI EN 301 489-01 V2.2.3 ETSI EN 301 489-17 V3.2.4 EN 55032:2015 + AC:2016 + A11:2020 FCC CFR 47 Subpart 15B ISED Canada ICES-003, Issue 7	PASS
Conducted Emissions (Telecom Port) (Method: CISPR 16-2-1:2017, Ed.3.1)	ETSI EN 301 489-01 V2.2.3 ETSI EN 301 489-17 V3.2.4 EN 55032:2015 + AC:2016 + A11:2020	N/A
Radiated Emissions (150kHz-30MHz) (Method: CISPR 16-2-3:2019, Ed.4.1)	New Zealand Gazette, No.2023-go4026	PASS
Radiated Emissions (Below 1GHz) (Method: CISPR 16-2-3:2019, Ed.4.1)	ETSI EN 301 489-01 V2.2.3 ETSI EN 301 489-17 V3.2.4 EN 55032:2015 + AC:2016 + A11:2020 FCC CFR 47 Subpart 15B ISED Canada ICES-003, Issue 7	PASS
Radiated Emissions (Above 1GHz) (Method: CISPR 16-2-3:2019, Ed.4.1)	ETSI EN 301 489-01 V2.2.3 ETSI EN 301 489-17 V3.2.4 EN 55032:2015 + AC:2016 + A11:2020 FCC CFR 47 Subpart 15B ISED Canada ICES-003, Issue 7	PASS
Harmonic Current Emissions (Method: EN IEC 61000-3-2:2021, Ed.5.1)	ETSI EN 301 489-01 V2.2.3 ETSI EN 301 489-17 V3.2.4	N/A
Voltage Variations/Fluctuations/Flicker (Method: EN 61000-3-3:2021, Ed.3.2)	ETSI EN 301 489-01 V2.2.3 ETSI EN 301 489-17 V3.2.4	N/A
Electrostatic Discharge (ESD) Immunity (Method: EN 61000-4-2:2009, Ed.2.0)	ETSI EN 301 489-01 V2.2.3 ETSI EN 301 489-17 V3.2.4	PASS

Requirements – Tests	Reference standards	Verdict
Radiated RF Disturbance Immunity (Method: EN 61000-4-3:2020, Ed.4.0)	ETSI EN 301 489-01 V2.2.3 ETSI EN 301 489-17 V3.2.4	PASS
Electric Fast Transients Immunity (Method: EN 61000-4-4:2012, Ed.3.0)	ETSI EN 301 489-01 V2.2.3 ETSI EN 301 489-17 V3.2.4	PASS
Surge Immunity (Method: EN 61000-4-5:2017, Ed.3.1)	ETSI EN 301 489-01 V2.2.3 ETSI EN 301 489-17 V3.2.4	N/A
Conducted RF Disturbance Immunity (Method: EN 61000-4-6:2014, Ed.4.0)	ETSI EN 301 489-01 V2.2.3 ETSI EN 301 489-17 V3.2.4	PASS
Voltage Dips and Interruptions Immunity (Method: EN IEC 61000-4-11:2020, Ed.3.0)	ETSI EN 301 489-01 V2.2.3 ETSI EN 301 489-17 V3.2.4	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 a test item that are not within Nemko’s scope of accreditation
- # : A grid (#) placed after the verdict in the Result column indicates a test item that are only partly covered by Nemko’s scope of accreditation. Further information or details may be provided within the test chapter

ABOUT REFERENCE STANDARDS AND TEST LEVELS

Product standards with dated references to basic standards may have been performed 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 if 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.

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.

NOTES

None

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.

- Artificial Hand was applied to the specimen during test (for location see photos)

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) (11/2024)
 EMI Receiver: R&S / ESCI 3 (N-4259) (12/2025)

Conformity

Verdict:

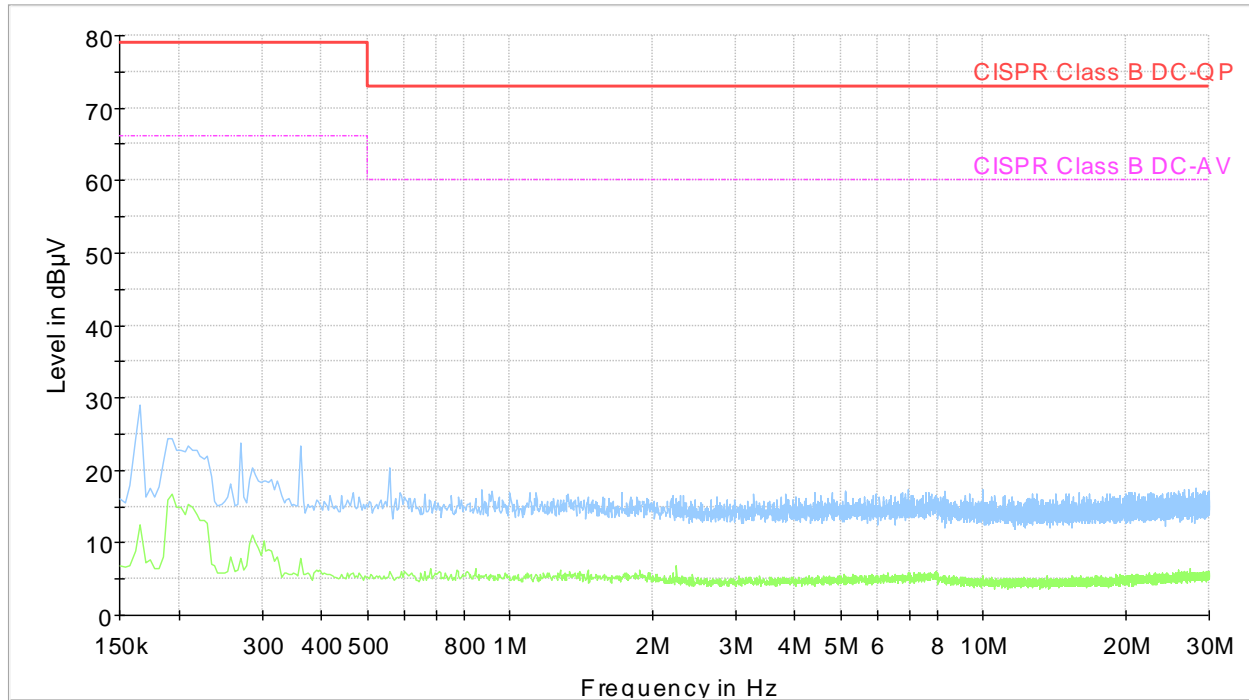
PASS

Test engineer:

TLO

EMISSION SPECTRUM DC EN

Full Spectrum



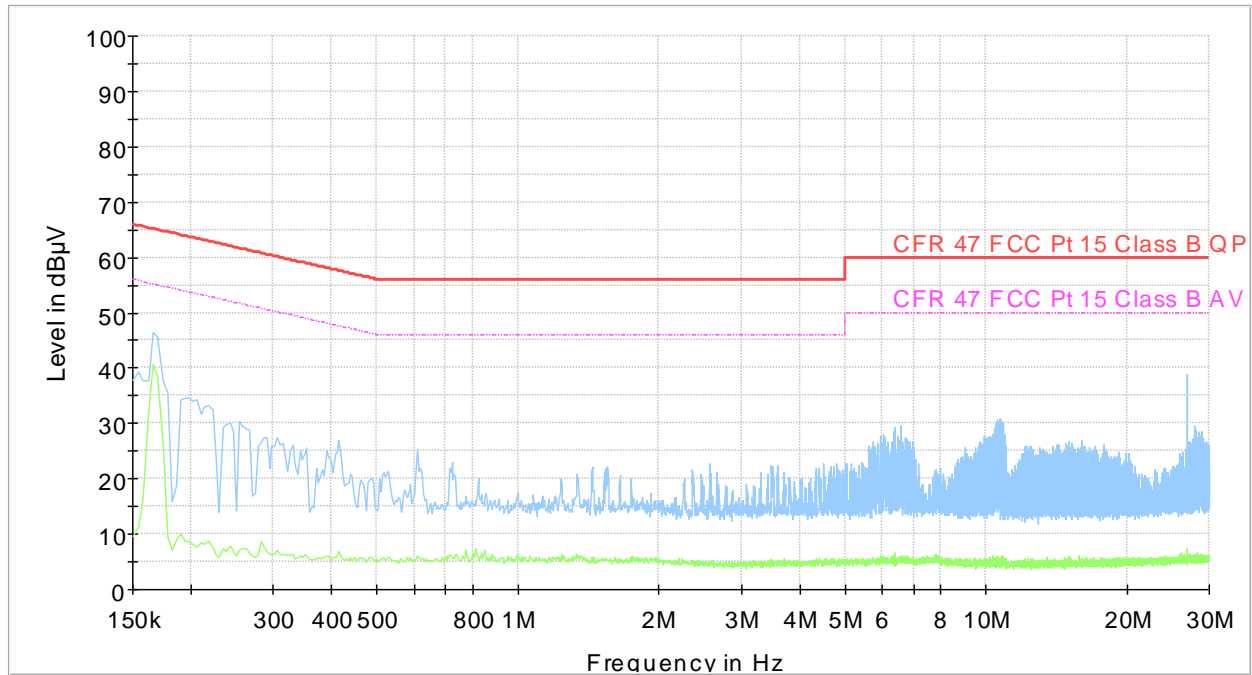
- Preview Result 2-AVG
- Preview Result 1-PK+
- CISPR Class B DC-QP
- - - CISPR Class B DC-AV
- ◆ Final_Result QPK
- ◆ Final_Result CAV

MEASUREMENT DATA

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)	Comment
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EMISSION SPECTRUM FCC

Full Spectrum



- Preview Result 2-AVG
- Preview Result 1-PK+
- CFR 47 FCC Pt 15 Class B QP
- CFR 47 FCC Pt 15 Class B AV
- ◆ Final_Result QPK
- ◆ Final_Result CAV

MEASUREMENT DATA

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)	Comment
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RADIATED EMISSIONS (150KHZ-30MHZ)

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.

The measuring antenna was located 3 meters from the specimen and 100 cm above the site ground plane. Measurements were performed with a 60 cm loop antenna oriented both longitudinal and transverse to the specimen.

Conditions

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: ± 1.5 dB (150 kHz – 30 MHz)

Instruments used during measurement

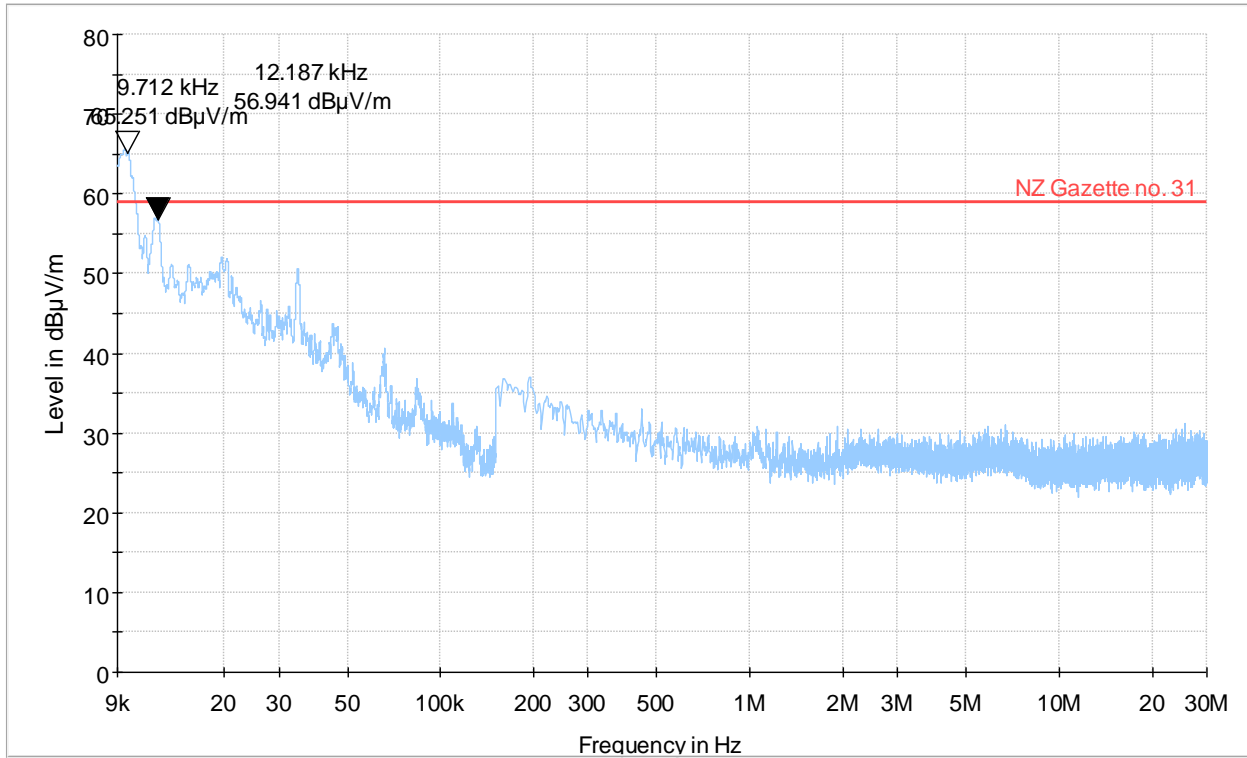
Instrument list: Antenna, loop: R&S / HFH2-Z2 (LR-1660) (01/2024)
 EMI Receiver: R&S / ESU40 (LR-1639) (01/2025)

Conformity

Verdict:	PASS
Test engineer:	TLO

EMISSION SPECTRUM (LONGITUDINAL)

Full Spectrum



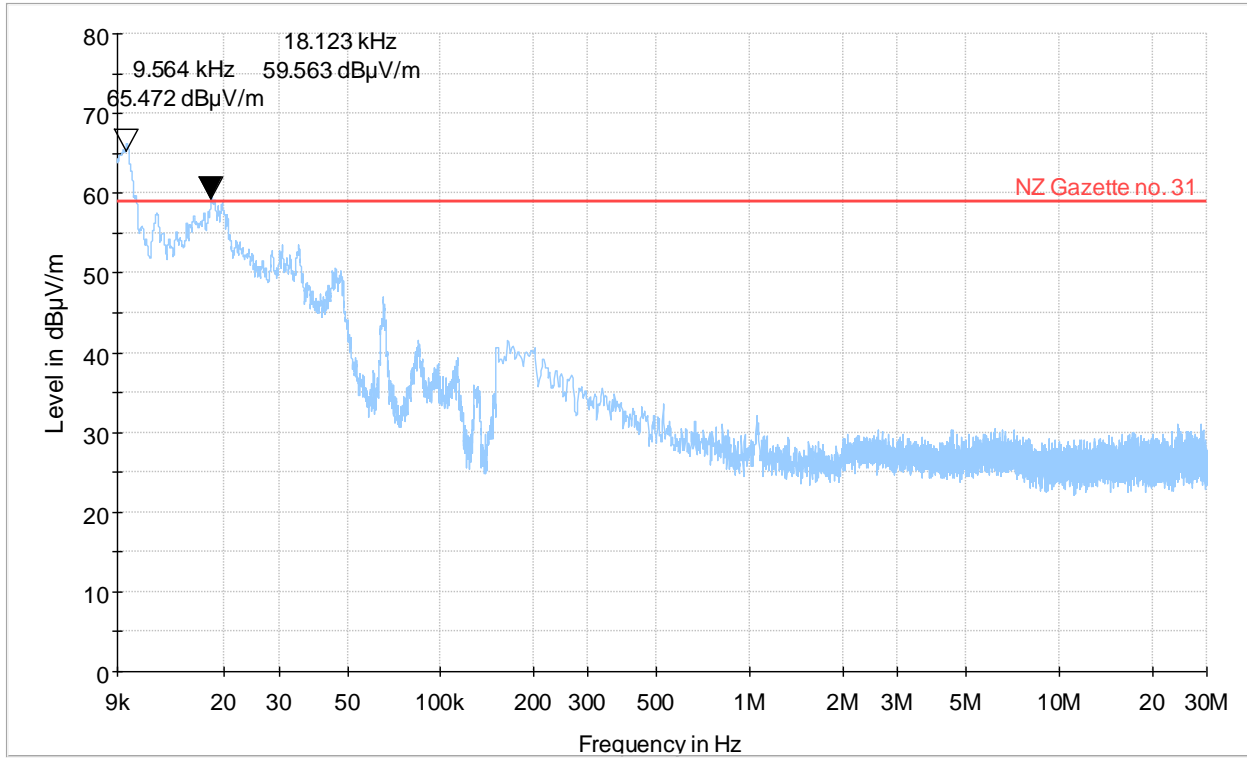
MEASUREMENTS DATA

There were no emissions originating from the EUT.

Emission levels are only ambient noise corrected for the antenna factor. That includes frequencies with levels above the limit

EMISSION SPECTRUM (TRANSVERSE)

Full Spectrum



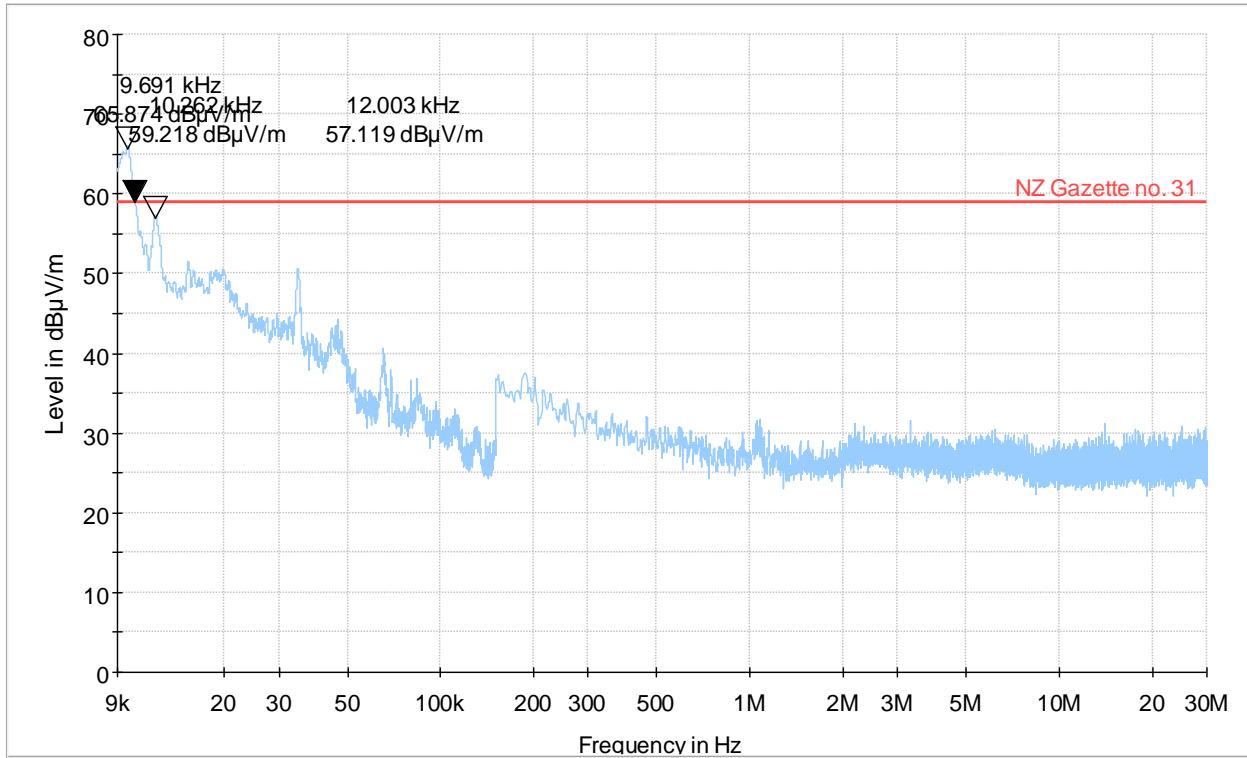
MEASUREMENTS DATA

There were no emissions originating from the EUT.

Emission levels are only ambient noise corrected for the antenna factor. That includes frequencies with levels above the limit

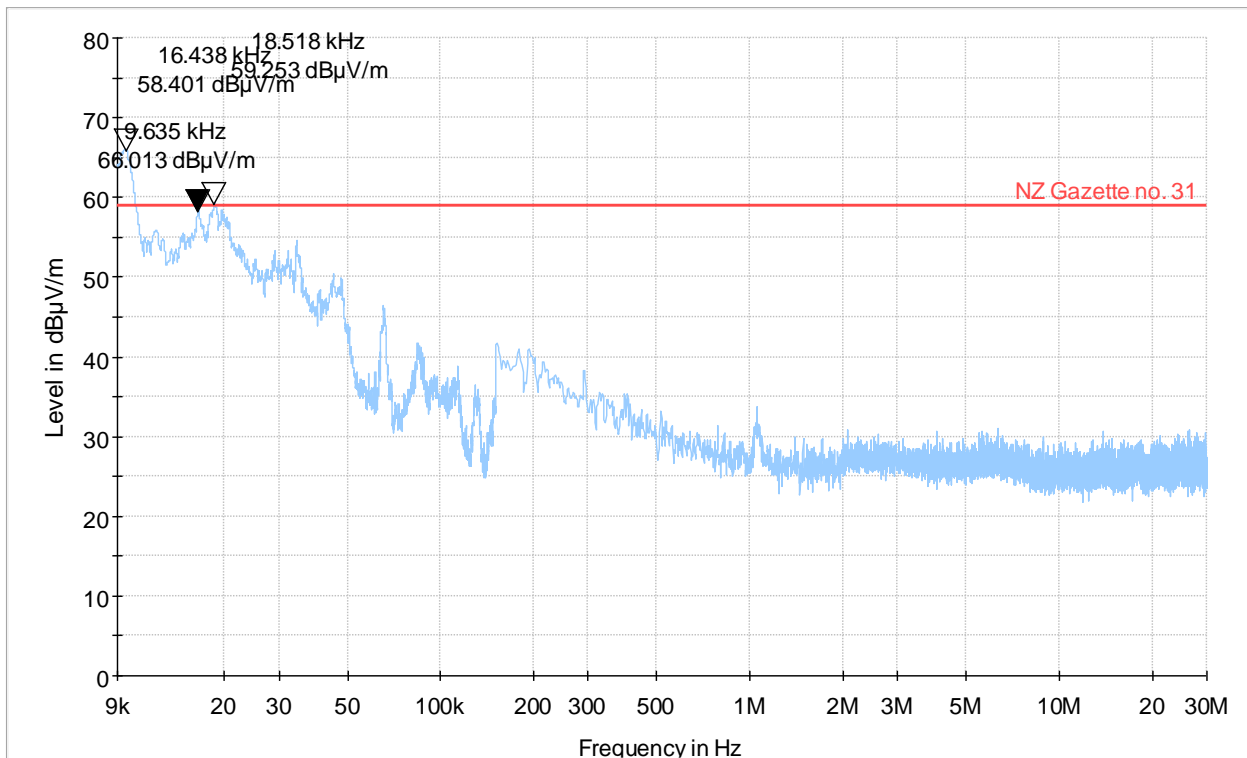
EMISSION SPECTRUM (LONGITUDINAL) SAME MEASUREMENT WITHOUT EUT

Full Spectrum



EMISSION SPECTRUM (TRANSVERSE) SAME MEASUREMENT WITHOUT EUT

Full Spectrum



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°.

- Band-stop filter(s) was used to suppress the wanted RF transmission band to protect the measurement equipment.

Frequency range:

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

Measurement distance:

- 3m
- 5m
- 10m

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, Hybrid: Sunol / JB3 (N-4525) (04/2025)
 Antenna, Hybrid: Schwarzbeck / VULB 9163 (LR-1616) (05/2025)
 EMI Receiver: R&S / ESU40 (LR-1639) (01/2025)
 Preamplifier: Sonoma / 310N (LR-1686) (08/2024)

Conformity

Verdict:

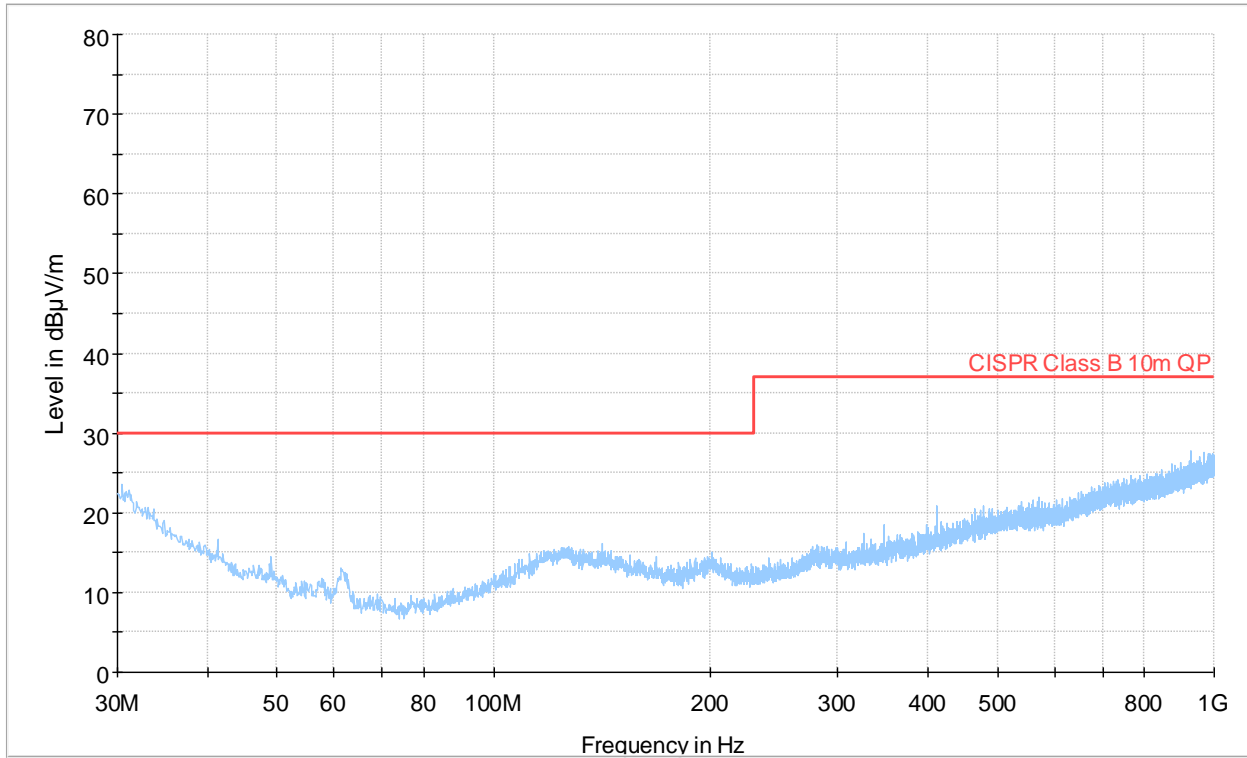
PASS

Test engineer:

TLO

EMISSION SPECTRUM DC EN

Full Spectrum

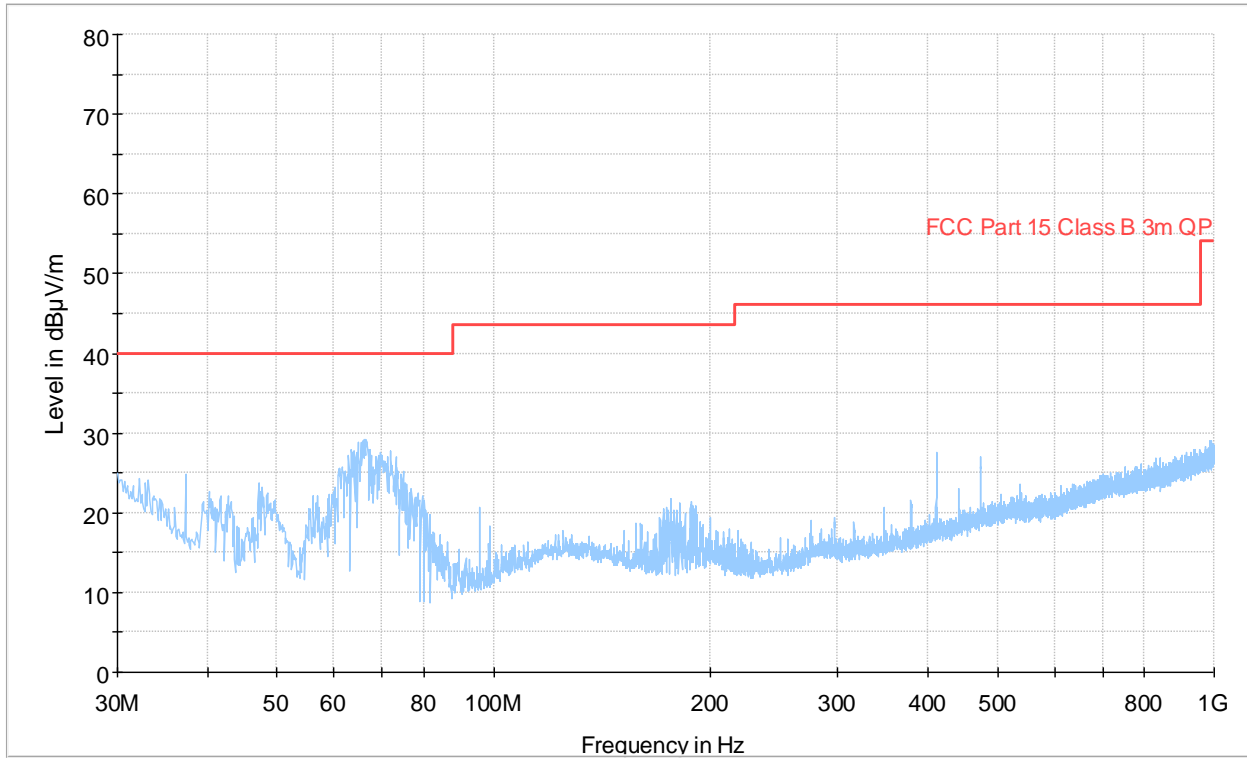


MEASUREMENTS DATA

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
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EMISSION SPECTRUM FCC

Full Spectrum



MEASUREMENTS DATA

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
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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 specimen and its cables were elevated 10 cm above the floor and placed in the centre of the turntable.
- The specimen and its cables were placed on a table 80 cm above the floor and placed in the centre of the turntable.

Facility:

- 3m semi-anechoic chamber (SAC3) with extra floor absorbers* (calibrated volume: D=2.0m / H=2.0m).
- 10m semi-anechoic chamber (SAC10) with extra floor absorbers* (calibrated volume: D=1.5m / H=2.0m).
- 3m fully anechoic room (FAR3) (calibrated volume: D=1.2m / H=2.0m).

* 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.

- Band-stop filter(s) was used to suppress the wanted RF transmission band to protect the measurement equipment.

Frequency range:

- 1-2GHz
- 1-5GHz
- 1-6GHz
- 1-12GHz

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) (12/2027)
 EMI Receiver: R&S / ESU40 (LR-1639) (01/2025)
 Preamplifier: ETS / 3117-PA (LR-1757) (08/2024)

Conformity

Verdict:

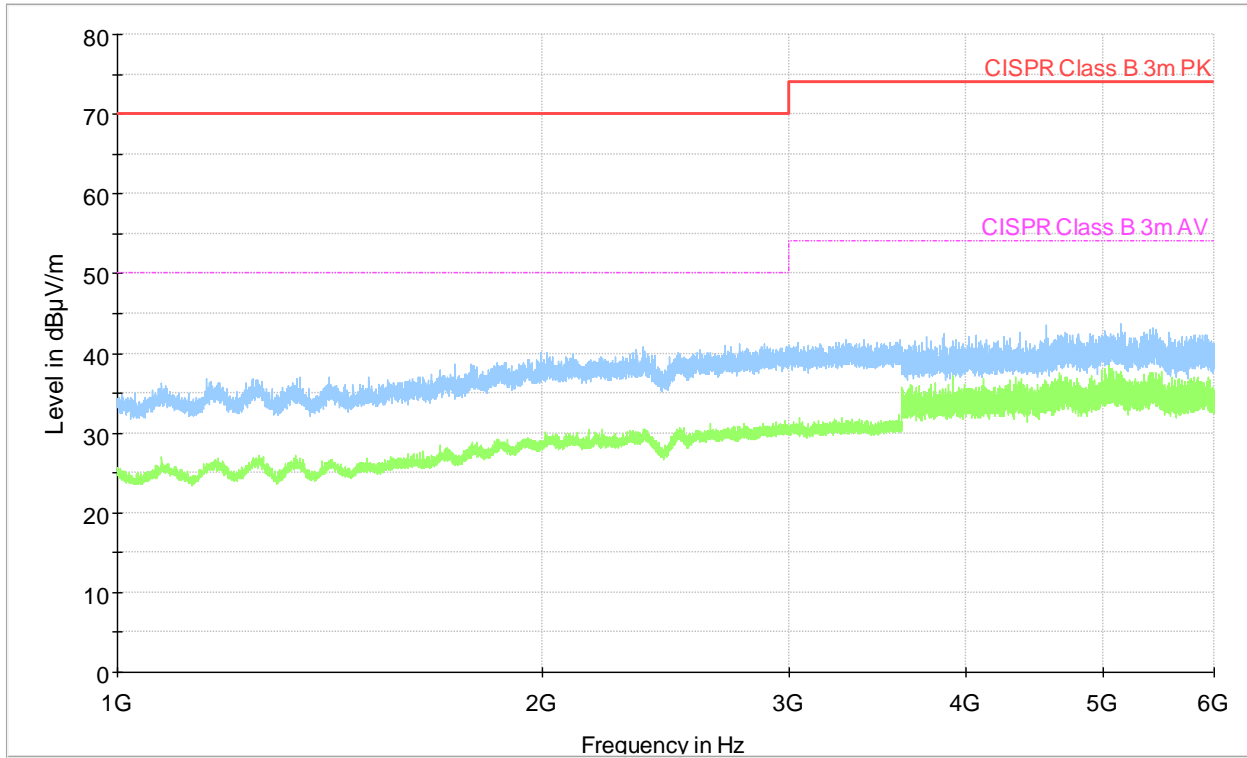
PASS

Test engineer:

TLO

EMISSION SPECTRUM (HORIZONTAL POLARIZATION) EN

Full Spectrum

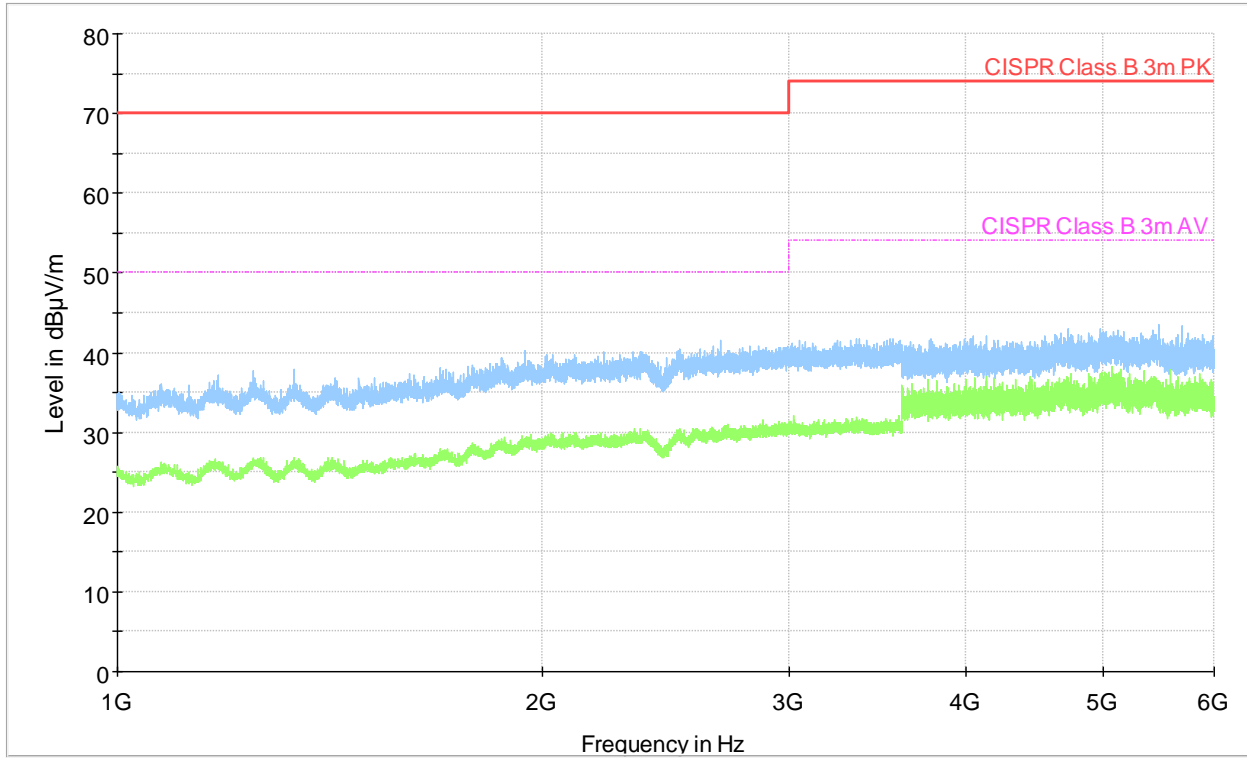


MEASUREMENTS DATA

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
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EMISSION SPECTRUM (VERTICAL POLARIZATION) EN

Full Spectrum

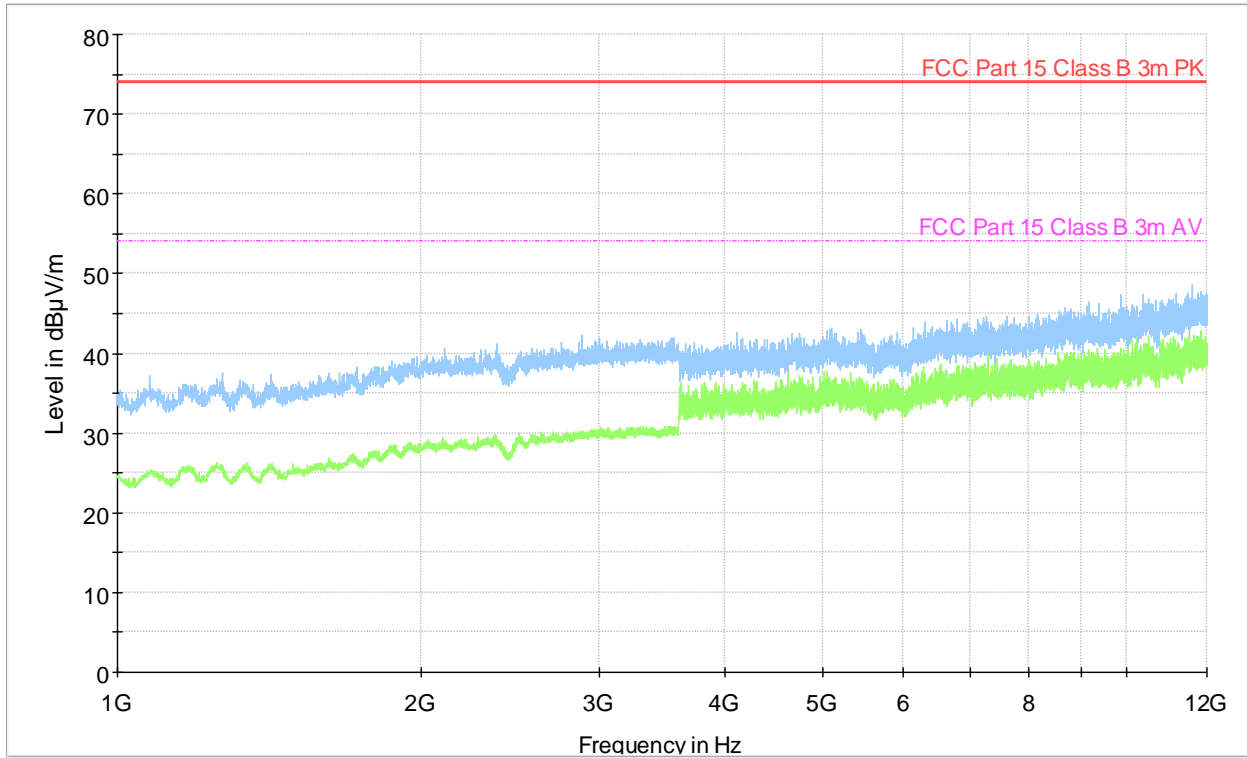


MEASUREMENTS DATA

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
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EMISSION SPECTRUM (HORIZONTAL POLARIZATION) FCC

Full Spectrum

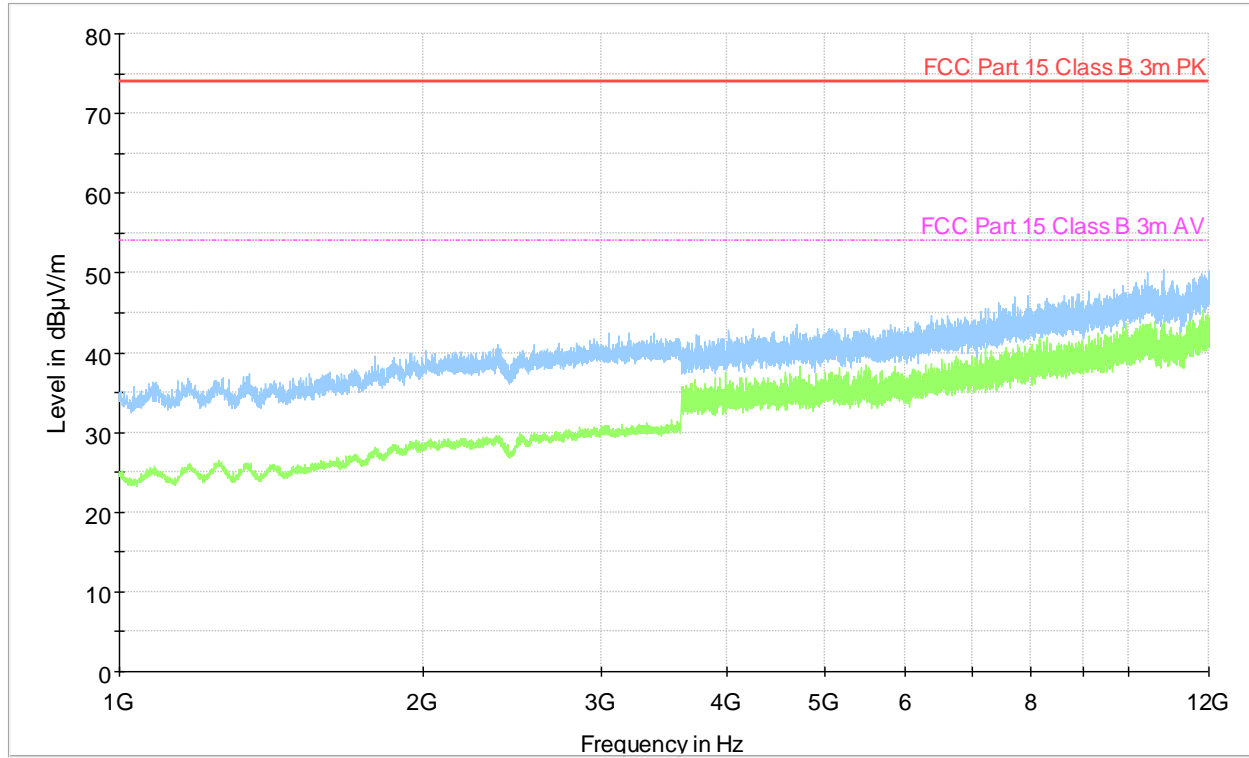


MEASUREMENTS DATA

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
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EMISSION SPECTRUM (VERTICAL POLARIZATION) FCC

Full Spectrum



MEASUREMENTS DATA

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
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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.
- Table top 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

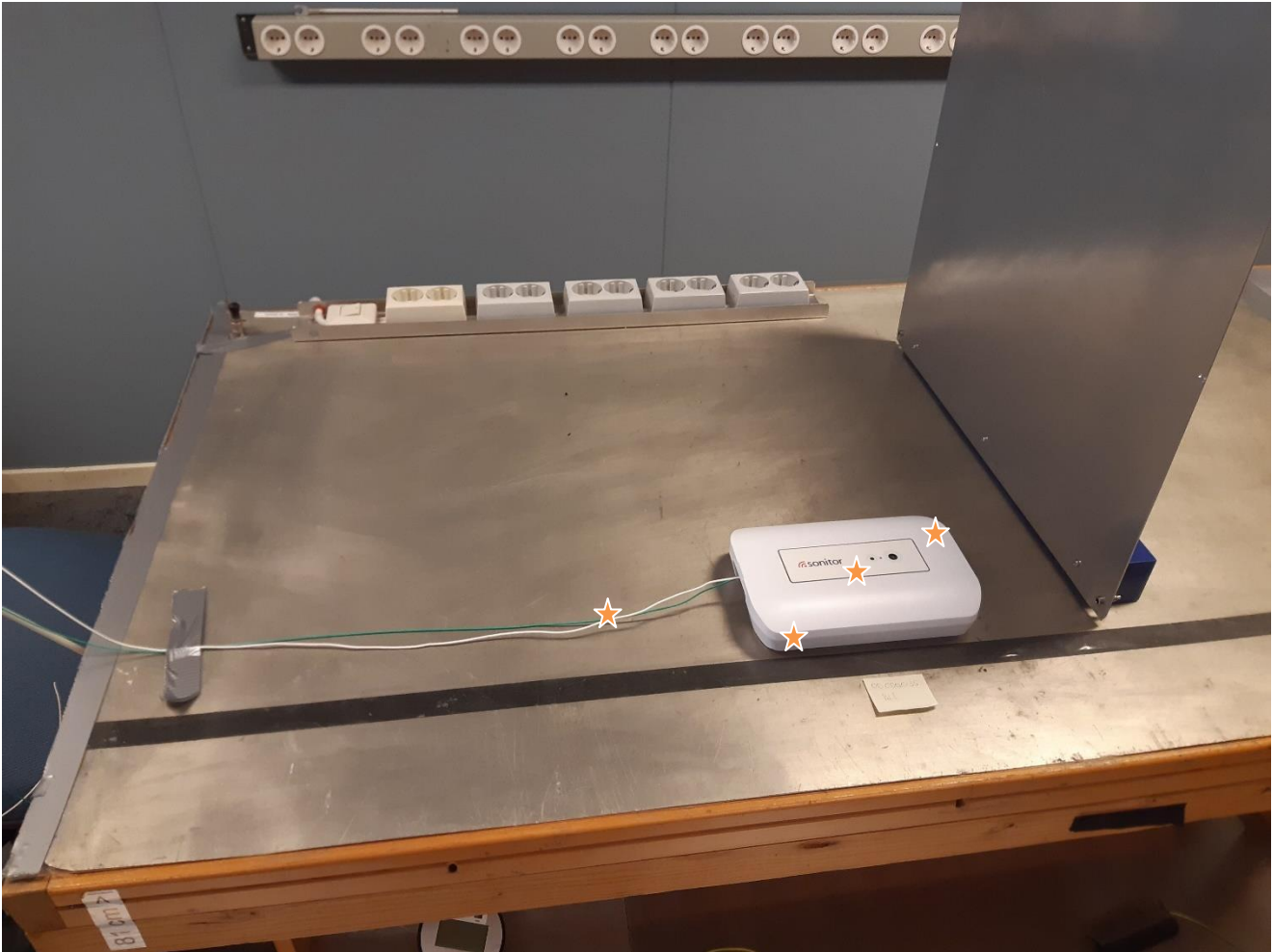
Instrument list: [ESD Generator: EMTest / Dito \(LR-1733\) \(02/2024\)](#)

Temperature:	22.5 °C
Humidity:	44.2 %RH
Atmos. pressure:	994.6 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
Enclosure	±2, ±4, ±8	Air	10	B	A	PASS
Transducer	±2, ±4, ±8	Air	10	B	A	PASS
Cable	±2, ±4, ±8	Air	10	B	A	PASS
HCP	±4	Contact	10	B	A	PASS
VCP	±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, RF: R&S / BBA150-D110E100 (LR-1721) (N/A)
 Amplifier, RF: R&S / BBA150-BC500 (LR-1720) (N/A)
 Antenna, Log-periodic: AR / ATR80M6G (LR-1724) (N/A)
 Field Probe: ETS / HI-6153 (LR-1722) (10/2026)
 Generator, RF: R&S / SMB100A (LR-1688) (07/2025)
 Power Sensor: R&S / NRP6AN (LR-1719) (07/2024)
 Power Sensor: R&S / NRP6AN (LR-1718) (07/2024)

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

OBSERVATIONS

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

ELECTRIC FAST TRANSIENTS IMMUNITY

TEST DESCRIPTION

Method

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

Set-up

Mains power was supplied to the specimen via the coupling network. The specimen was energized and in normal operating condition.

- The specimen and its cables were elevated 10 cm above the reference ground plane.
- Artificial hand was applied during test (for location see photos).

Procedure

Transients were applied at increasing levels to each single line at the AC or DC input port using a coupling network, and to relevant signal ports using a capacitive coupling clamp.

Duration:

- 1 minute
- 2 minutes
- 5 minutes

Repetition frequency:

- 5kHz
- 100kHz

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: Generator: EMTTest / UCS 500 N7 (LR-1608) (06/2025)

Conformity

Verdict:

PASS

Test engineer:

TLO

DETAILED TEST LOG

Port	Applied Level [kV]	Injection Method	Required Criteria	Complied Criteria	Result
DC Input Port (N+L1+PE)	$\pm 0.5\text{kV}$	CDN	B	A	PASS
DC Input Port (N+L1+PE)	$\pm 1\text{kV}$	CDN	B	A	PASS

OBSERVATIONS

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

CONDUCTED RF DISTURBANCE IMMUNITY

TEST DESCRIPTION

Method

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

Set-up

Mains power was supplied to the specimen via the coupling network. The specimen was energized and in normal operating condition.

- The specimen was elevated 10 cm above the reference ground plane.
- Cables were elevated 5 cm above the reference ground plane.
- Artificial hand was applied during test (for location see photos).

All specimen ports, which are not subject to testing, are furnished with decoupling networks to achieve RF isolation of the specimen during test. A return path was created according to the priority given in §7.2 of the reference standard.

Procedure

Disturbance was applied via a coupling/decoupling network (CDN) or an electromagnetic coupling clamp (EM Clamp) to each port separately.

- | | | |
|--|---|---|
| Frequency range: | Modulation: | Frequency sweep rate: |
| <input checked="" type="checkbox"/> 150kHz – 80MHz | <input checked="" type="checkbox"/> 80% AM @ 1000Hz | <input checked="" type="checkbox"/> 1% step with 3 sec dwell time |
| <input type="checkbox"/> 150kHz – 230MHz | <input type="checkbox"/> 80% AM @ 400Hz | <input type="checkbox"/> 1.5x10 ⁻³ decades/sec |
| <input type="checkbox"/> Spot frequencies | <input type="checkbox"/> 50% PM @ 217Hz | <input type="checkbox"/> Other: |

Measurement uncertainty: ± 1.7dB (CDN method); ± 3.2dB (EM Clamp method); ± 3.3dB (BCI method)

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, RF: AR / 75A250 (N-3816) (N/A)
 CDN: FCC / FCC-801-M2-16 (LR-1312) (N/A)
 Directional Coupler: AR / DC2600A (N-5045) (N/A)
 Generator, signal: R&S / SMB100A (LR-1649) (07/2025)
 Power Sensor: R&S / NRP-Z92 (LR-1650) (10/2025)

Conformity

Verdict: **PASS**
 Test engineer: **TLO**

DETAILED TEST LOG

Tested Port	Injection Method	Return Path	Applied Level [Vrms]	Required Criteria	Complied Criteria	Result
DC Input Port	CDN-M2	Capacitive	3 Vrms	A	A	PASS

OBSERVATIONS

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

POWER FREQUENCY MAGNETIC FIELDS 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 during test.

The tests were performed with a single squared 100x100 cm coil. The specimen was placed in the centre of the coil above a ground reference plane.

Procedure

The specimen was exposed to the magnetic field of a magnitude and frequency as specified below. Then the coil orientation was changed to repeat the testing in the 3 orthogonal axes (X, Y and Z).

Duration:

- 1 minute
- 5 minutes
- Time necessary for a full operating cycle:

Uncertainty figures:

Field level: $\pm 2.5\%$
Frequency: $\pm 1\%$
Distortion: $<2\%$

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:

Conformity

Verdict:

Test engineer:

DETAILED TEST LOG

Axis [X/Y/Z]	Field Strength [A/m]	Field Frequency	Required Criteria	Complied Criteria	Result
X	10	AC 50Hz	A		PASS
Y	10	AC 50Hz	A		PASS
Z	10	AC 50Hz	A		PASS
X	10	AC 60Hz	A		PASS
Y	10	AC 60Hz	A		PASS
Z	10	AC 60Hz	A		PASS

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



Test set-up for EMC immunity tests

