

Test Report

Electromagnetic Compatibility

Product	Irrigation sensor		
Name and address of the applicant	7Sense Products AS Moloveien 14 3187 Horten, Norway		
Name and address of the manufacturer	7Sense Products AS Moloveien 14 3187 Horten, Norway		
Model	Irrigation sensor 21-1020-AC		
Rating	3.6V DC		
Trademark			
Additional information	Product with LTE and GNSS.		
Tested according to	FCC CFR 47 Subpart 15B ISED Canada ICES-003, Issue 7 ETSI EN 301 489-01 V2.2.3 ETSI EN 301 489-19 V2.2.1 ETSI EN 301 489-52 V1.3.1 EN IEC 61326-1:2021 New Zealand Gazette, No.31		
Project number	PRJ0067739		
Tested in period	2025-03-03 to 2025-03-05		
Issue date	2025-12-18		
Name and address of the testing laboratory	Nemko Scandinavia AS ☐ Location 1: Philip Pedersens vei 11, 1366 Lysaker, Norway ☒ Location 2: Instituttveien 6, 2007 Kjeller, Norway  		
An accredited technical test executed under the Norwegian accreditation scheme			
 Prepared by [Thanh Tran]  Approved by [Jan Gunnar Erksen]			

REPORT REVISIONS

Report Edition	Date	Project	Description
A	2025-03-17	PRJ0067739	First issued
B	2025-12-18	PRJ0067739	Updating with adding the FCC ID and IC



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 tested item is an irrigation sensor. The sensor is a durable, waterproof monitor that is attached to the pipe or hose of an irrigation system. It measures pressure by detecting vibrations and track's location using GPS coordinates. If any issues arise, such as water loss or system overturns, it alerts the user
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Model/type	Irrigation sensor 21-1020-AC
Serial number	21-1020-AC-00776
FCC ID	2ANP000NRF9160
IC	24529-NRF9160
Operating voltage.....	3.6V DC (Replaceable battery: 3.6V, 1300Ah, 1.8A Lithium D-cell type))
Maximum power/current.....	2.88W / 800mA
Insulation class	/
Highest clock frequency	64MHz processor, 800-900MHz antenna band
Hardware version	B
Software version	1.4.5

Mounting position.....	☐ Tabletop equipment ☐ Wall/ceiling mounted equipment ☐ Floor standing equipment ☐ Handheld equipment ☐ Rack mounted equipment ☐ Console equipment ☒ Other: Portable sensor, mounted horizontally on a water pipe
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RF CHARACTERISTICS OF THE TRANSMITTER

Type	LTE	GNSS
Frequency range.....	LTE Band 1, 3, 8, 20 and 28	1561.098 MHz, 1575.42 MHz, 1598.0625 - 1609.3125 MHz
Number of channels	LTE Band 1, 3, 8, 20 and 28	BeiDou (B1I), GPS (L1 C/A), GLONASS (L1/CA),
Channel BW	1.4MHz	72-channel M8 engine receiver type
Rated output power	Below 23 dBm	N/A
Operating modes.....	TX/RX	RX
Types of modulation	16-QAM	N/A
Tunable bands	No	N/A
User frequency adjustment.....	No	N/A
Antenna type.....	Integral antenna	Integral antenna
Antenna gain	1.6dBi	N/A
Antenna connection	No	No
Number of antennas	1	1
Antenna diversity/MIMO	No	N/A

CRITICAL MODULES/PARTS

Description	Manufacturer	Type
Battery	SAFT	LSH20
Circuit board	7Sense	4294_00_10B
Microcontroller (for GNSS)	Nordic semiconductor	nRF9160-SICA
Microcontroller (for LTE)	Nordic semiconductor	nRF9160-SICA

ACCESSORIES USED DURING TEST

Description	Manufacturer	Type
J-tag	Segger	/
Computer	Apple	Macbook air
Programming SW	Putty	Terminal

INPUT/OUTPUT PORTS

Port name and description	Cable		
	Longer than 3m	Attached during test	Shielded
None	☐	☐	☐

OPERATING MODES

OP no.	Description	Applied for testing	
		Emissions	Immunity
OP1	<u>Idle</u>	☐	☐
OP2	<u>Idle clock wait</u>	☐	☐
OP3	<u>Idle Activity</u>	☐	☐
OP1	<u>Pre settling</u>	☒	☒
OP2	<u>Irrigation</u> (with LTE and GNSS connection)	☒	☒
OP3	<u>Post settling</u>	☐	☐
OP1	<u>Idle off season</u>	☐	☐
OP2	<u>Irrigation near end point</u>	☐	☐
OP3	Idle autostart	☐	☐

POWER SUPPLY CONDITIONS

The following nominal power supply conditions have been tested:

PC no.	Voltage	Frequency	Type	Ground terminal
PC1	3.6V	☐ AC 50Hz / ☐ AC 60Hz / ☒ DC	☐ 3AC / ☐ 3ACN / ☐ PoE	☐ PE / ☐ GND / ☒ None

OTHER INFORMATION

Modifications	None
Additional information	Test software. Changed threshold for vibration monitoring to 0, so the sensor can remain in active state. Ordinary software has a maximum of transmission each 10 th minute and returns to idle when no water is detected.

TEST ENVIRONMENT

Test laboratory	☒ KJELLER (Instituttveien 6, N-2007 Kjeller, Norway) ☐ LYSAKER (Philip Pedersens vei 11, N-1366 Lysaker, Norway)
Laboratory accreditation	 Norsk Akkreditering – TEST 033 P06 – Electromagnetic Compatibility
Environmental conditions	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: Ambient temperature: 15 – 35 °C Relative humidity: 25 – 75 %RH Atmospheric pressure: 86 – 106 kPa 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.
Calibration	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.
Measurement uncertainties	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%. If some emission measurements have a margin to the required limit which is less than the instrumentation measurement uncertainty provided by the laboratory, occurrences are marked with an asterisk (*) in the "Margin" columns. 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>
Decision rules	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>

EVALUATION OF PERFORMANCE

PERFORMANCE TESTS

Performance checks	Set up EUT (the sensor) in operating mode with connection LTE and GNSS. The sensor transmitted data packets every 15-20 seconds to 7sense backed/server with LTE connection. An ancillary PC with wifi connection used for online nemonitoring the transmissions to ensure data integrity and functionality during the test.
Performance tests	Deliver data and acquire GNSS location, power on.
Monitoring during tests	Set up EUT (the sensor) in operating mode with connection LTE and GNSS. The sensor transmitted data packets every 15-20 seconds to 7sense backed/server with LTE connection. An ancillary PC with wifi connection used for online nemonitoring the transmissions to ensure data integrity and functionality during the test. The monitoring process involved: - Receiving and logging sensor data packets. - Verifying the acknowledgment (Ack) responses from the 7sense portal. - Analyzing the JSON payloads sent to the development portal. - Checking decrypted payload data for inconsistencies or abnormal values. - Ensuring the sensor continued to operate within expected parameters. Monitoring the flashing green LED (operating mode) on EUT during test.
Information: Performance check is a short functional test carried out during or after a technical test to confirm that the equipment operates. 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. Monitoring during tests describes which functions were monitored and how.	

☒ This test report contains functional evaluation data provided by the customer. Some pass/fail statements are based on such evaluations and data provided by customer auxiliary equipment. Data originating from the customer are not obtained under the accreditation conditions of the laboratory.

GENERAL PERFORMANCE CRITERIA

For the specimen to pass each test, it 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.
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 (A, B or C, CT, TT, CR or TR).	

TRANSMITTER PERFORMANCE CRITERIA

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

During continuous tests	During transient tests
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.	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.
Modification by the manufacturer: Not modified	Modification by the manufacturer: Not modified
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).	

RECEIVER PERFORMANCE CRITERIA

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

During continuous tests	During transient tests
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.	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.
Modification by the manufacturer: Not modified	Modification by the manufacturer: Not modified
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).	

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 301 489-19 V2.2.1	<i>Electromagnetic compatibility and Radio spectrum Matters (ERM); Electromagnetic compatibility (EMC) standard for radio equipment and services; Part 19: Specific conditions for Receive Only Mobile Earth Stations (ROMES) operating in the 1,5 GHz band providing data communications</i>
ETSI EN 301 489-52 V1.3.1	<i>Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 52: Specific conditions for Cellular Communication. User Equipment (UE) radio and ancillary equipment; Harmonised Standard for ElectroMagnetic Compatibility</i>
EN IEC 61326-1:2021	<i>Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General 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.31 *	<i>Radiocommunications Regulations (Radio Standards) Notice 2016, 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 301 489-19 V2.2.1 ETSI EN 301 489-52 V1.3.1 EN IEC 61326-1:2021	N/A
Conducted Emissions (Method: FCC Part 12.107 per ANSI C63.4-2014)	FCC CFR 47 Subpart 15B ISED Canada ICES-003, Issue 7	N/A
Conducted Emissions (Telecom Port) (Method: CISPR 16-2-1:2017, Ed.3.1)	ETSI EN 301 489-01 V2.2.3 ETSI EN 301 489-19 V2.2.1 ETSI EN 301 489-52 V1.3.1	N/A
Discontinuous Conducted Emissions (Method: CISPR 16-2-1:2017, Ed.3.1)	EN IEC 61326-1:2021	N/A
Radiated Emissions (9kHz-30MHz) (Method: CISPR 16-2-3:2019, Ed.4.1)	New Zealand Gazette, No.31	PASS
Radiated Emissions (Below 1GHz) (Method: CISPR 16-2-3:2019, Ed.4.1)	ETSI EN 301 489-01 V2.2.3 ETSI EN 301 489-19 V2.2.1 ETSI EN 301 489-52 V1.3.1 EN IEC 61326-1:2021	PASS
Radiated Emissions (Below 1GHz) (Method: FCC Part 12.109 per ANSI C63.4-2014)	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 301 489-19 V2.2.1 ETSI EN 301 489-52 V1.3.1 EN IEC 61326-1:2021	PASS

Requirements – Tests	Reference standards	Verdict
Radiated Emissions (Above 1GHz) (Method: FCC Part 12.109 per ANSI C63.4-2014)	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 301 489-19 V2.2.1 ETSI EN 301 489-52 V1.3.1 EN IEC 61326-1:2021	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 301 489-19 V2.2.1 ETSI EN 301 489-52 V1.3.1 EN IEC 61326-1:2021	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 301 489-19 V2.2.1 ETSI EN 301 489-52 V1.3.1 EN IEC 61326-1:2021	PASS
Radiated RF Disturbance Immunity (Method: EN IEC 61000-4-3:2020, Ed.4.0)	ETSI EN 301 489-01 V2.2.3 ETSI EN 301 489-19 V2.2.1 ETSI EN 301 489-52 V1.3.1 EN IEC 61326-1:2021	PASS
Electric Fast Transients Immunity (Method: EN 61000-4-4:2012, Ed.3.0)	ETSI EN 301 489-01 V2.2.3 ETSI EN 301 489-19 V2.2.1 ETSI EN 301 489-52 V1.3.1 EN IEC 61326-1:2021	N/A
Surge Immunity (Method: EN 61000-4-5:2017, Ed.3.1)	ETSI EN 301 489-01 V2.2.3 ETSI EN 301 489-19 V2.2.1 ETSI EN 301 489-52 V1.3.1 EN IEC 61326-1:2021	N/A
Conducted RF Disturbance Immunity (Method: EN IEC 61000-4-6:2023, Ed.5.0)	ETSI EN 301 489-01 V2.2.3 ETSI EN 301 489-19 V2.2.1 ETSI EN 301 489-52 V1.3.1 EN IEC 61326-1:2021	N/A
Power Frequency Magnetic Field Immunity (Method: EN 61000-4-8:2010, Ed.2.0)	EN IEC 61326-1:2021	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 301 489-19 V2.2.1 ETSI EN 301 489-52 V1.3.1 EN IEC 61326-1:2021	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

RADIATED EMISSIONS (9KHZ-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 1kHz in the frequency range 9kHz - 150 kHz and 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: ± 2.9 dB (150 kHz – 30 MHz)

Instruments used during measurement

Instrument list: [Antenna, loop: R&S / HFH2-Z2 \(LR-1660\) \(N/A\)](#)
 [EMI Receiver: R&S / ESU40 \(LR-1639\) \(01/2026\)](#)

Conformity

Verdict:

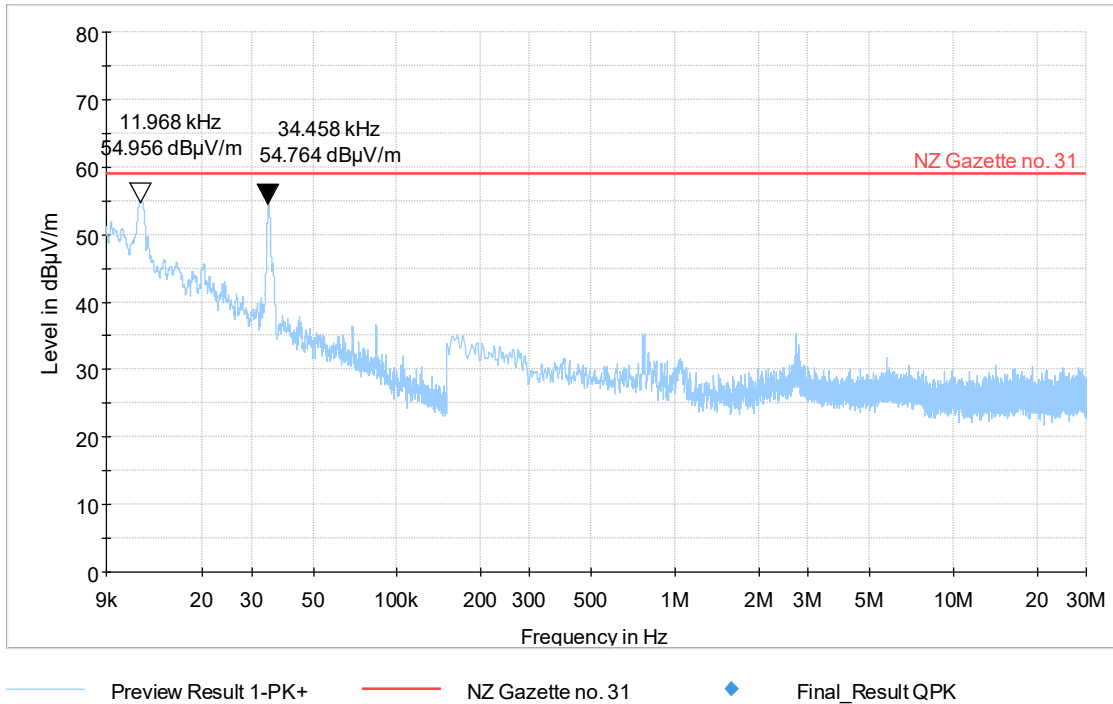
PASS

Test engineer:

Thanh Tran

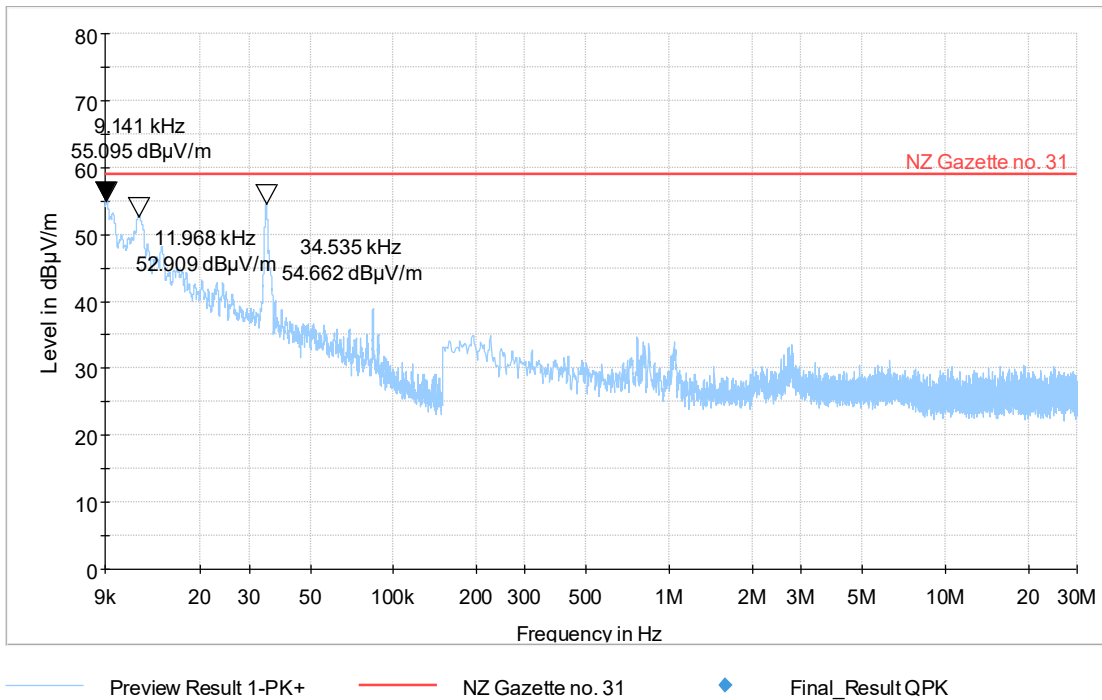
EMISSION SPECTRUM AND MEASUREMENTS DATA (LONGITUDINAL)

Full Spectrum



EMISSION SPECTRUM AND MEASUREMENTS DATA (TRANSVERSE)

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 with bore-sight movement.

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: ± 5.2 dB (3m distance in SAC10); ± 5.1 dB (3m distance in SAC3); ± 5.2 dB (10m distance in SAC10)

Instruments used during measurement

Instrument list: Antenna, Hybrid: Sunol / JB3 (N-4525) (04/2025)
 Preamplifier: Sonoma / 310N (LR-1686) (08/2025)
 EMI Receiver: R&S / ESU40 (LR-1639) (01/2026)

Conformity

Verdict:

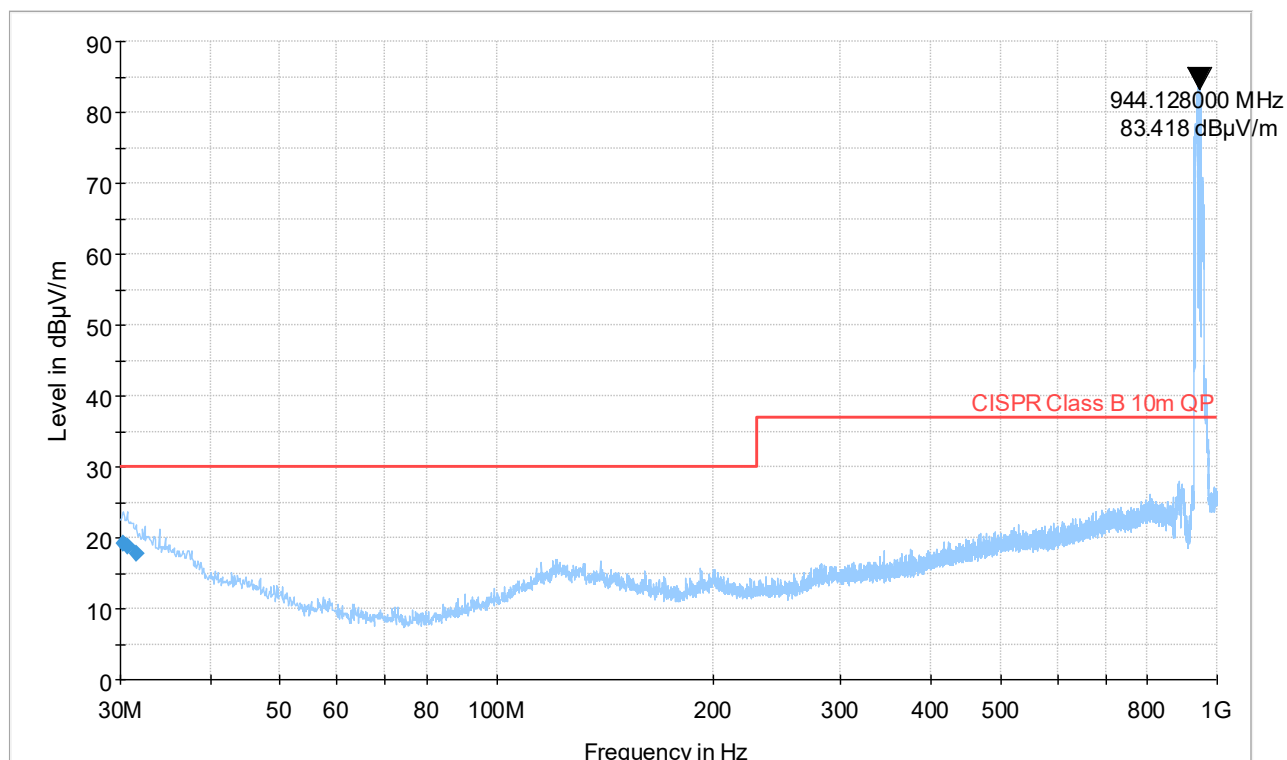
PASS

Test engineer:

Thanh Tran

EMISSION SPECTRUM

Full Spectrum



The frequency range 925-960MHz is LTE band 08 downlink.

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)
30.285924	19.11	30.00	10.89	15000.0	120.000	115.0	H	168.0	-4.3
30.670108	18.68	30.00	11.32	15000.0	120.000	150.0	H	357.0	-4.6
31.553008	17.76	30.00	12.24	15000.0	120.000	209.0	V	176.0	-5.4

RADIATED EMISSIONS (BELOW 1GHZ) FOR FCC 15B

TEST DESCRIPTION

Method

These measurements have been performed according to ANSI C63.4-2014.

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.

Antenna type = Hybrid bilog antenna

Antenna elevation = 100-400 cm above the ground reference plane with bore-sight movement.

Specimen rotation = 0-360°.

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

Frequency range:

- ☒ 30-1000MHz

Measurement distance:

- ☒ 3m

Conditions

The measuring bandwidth is 120 kHz in the frequency range 30 MHz – 960 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: ± 5.2 dB (3m distance in SAC10); ± 5.1 dB (3m distance in SAC3)

Instruments used during measurement

Instrument list: [Antenna, Hybrid: Sunol / JB3 \(N-4525\) \(04/2025\)](#)
 [Preamplifier: Sonoma / 310N \(LR-1686\) \(08/2025\)](#)
 [EMI Receiver: R&S / ESU40 \(LR-1639\) \(01/2026\)](#)

Conformity

Verdict:

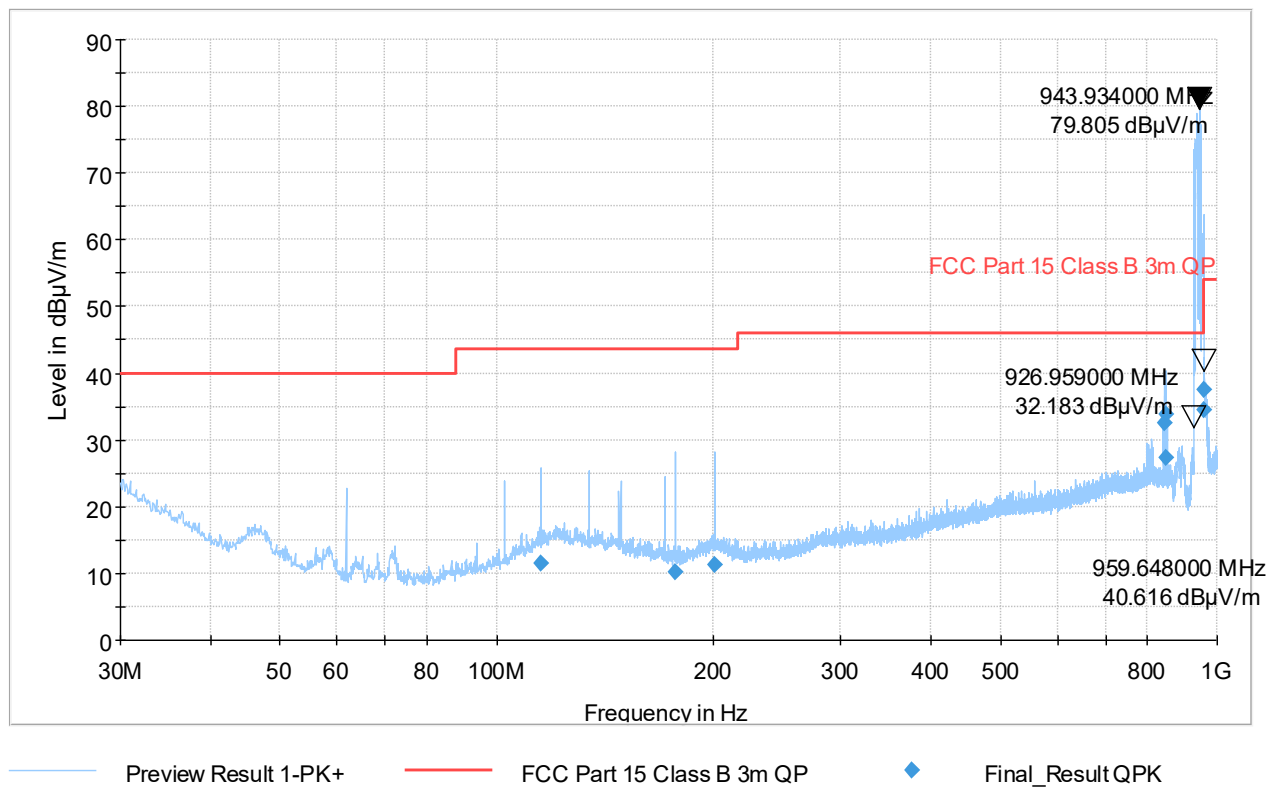
PASS

Test engineer:

Thanh Tran

EMISSION SPECTRUM

Full Spectrum



The frequency range 925-960MHz is LTE band 08 downlink.

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)
115.289028	11.45	43.50	32.05	15000.0	120.000	106.0	H	298.0	-11.6
176.679316	10.16	43.50	33.34	15000.0	120.000	144.0	H	267.0	-12.9
200.890440	11.38	43.50	32.12	15000.0	120.000	138.0	H	283.0	-11.5
844.152516	32.44	46.00	13.56	15000.0	120.000	150.0	V	43.0	0.0
847.694612	27.26	46.00	18.74	15000.0	120.000	150.0	V	356.0	0.1
850.656952	33.78	46.00	12.22	15000.0	120.000	124.0	V	0.0	0.1
960.083626	37.47	54.00	16.53	15000.0	120.000	224.0	H	331.0	2.5
960.909684	34.56	54.00	19.44	15000.0	120.000	150.0	H	202.0	2.5

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 (1-6GHz); ± 5.2 dB (6-18GHz)

Instruments used during measurement

Instrument list: Antenna, Horn: ETS / 3117 (LR-1717) (01/2030)
EMI Receiver: R&S / ESU40 (LR-1639) (01/2026)
Preamplicifier: ETS / 3117-PA (LR-1757) (12/2025)

Conformity

Verdict:

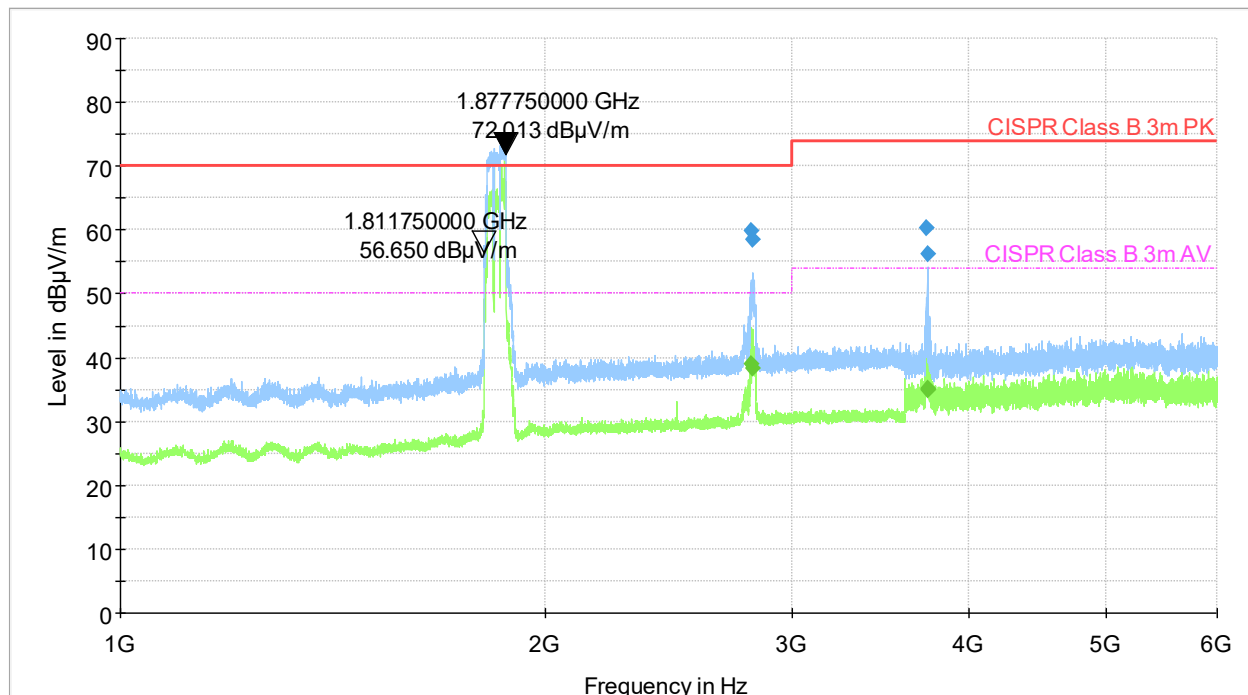
PASS

Test engineer:

Thanh Tran

EMISSION SPECTRUM (HORIZONTAL POLARIZATION)

Full Spectrum



— Preview Result 2-AVG
 — Preview Result 1-PK+
 — CISPR Class B 3m PK
— CISPR Class B 3m AV
 ◆ Final_Result PK+
 ◆ Final_Result CAV

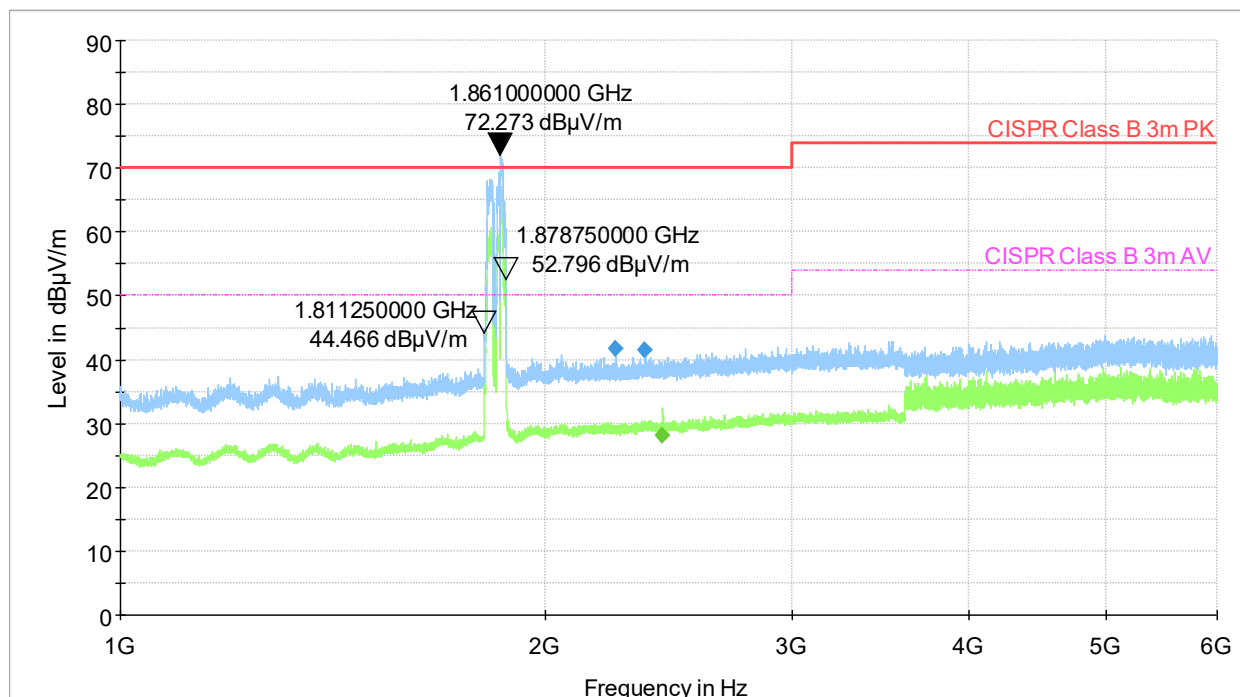
The frequency range 1805-1880MHz is LTE band 03 downlink.

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)
2805.566400	59.94	---	70.00	10.06	15000.0	1000.000	100.0	H	294.0	-7.6
2806.000000	---	39.04	50.00	10.96	15000.0	1000.000	100.0	H	324.0	-7.6
2811.224000	58.58	---	70.00	11.42	15000.0	1000.000	100.0	H	245.0	-7.6
2811.500000	---	38.39	50.00	11.61	15000.0	1000.000	100.0	H	324.0	-7.6
3736.020400	60.40	---	74.00	13.60	15000.0	1000.000	100.0	H	307.0	-4.1
3736.750000	---	35.12	54.00	18.88	15000.0	1000.000	100.0	H	324.0	-4.1
3737.500000	---	34.97	54.00	19.03	15000.0	1000.000	100.0	H	324.0	-4.1
3738.596800	56.28	---	74.00	17.72	15000.0	1000.000	100.0	H	324.0	-4.0

EMISSION SPECTRUM (VERTICAL POLARIZATION)

Full Spectrum



— Preview Result 2-AVG — Preview Result 1-PK+ — CISPR Class B 3m PK
- - - CISPR Class B 3m AV ◆ Final_Result PK+ ◆ Final_Result CAV

The frequency range 1805-1880MHz is LTE band 03 downlink.

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)
2246.785200	41.77	---	70.00	28.23	15000.0	1000.000	100.0	V	64.0	-9.8
2357.715600	41.42	---	70.00	28.58	15000.0	1000.000	100.0	V	147.0	-9.5
2425.750000	---	28.01	50.00	21.99	15000.0	1000.000	100.0	V	147.0	-9.2

RADIATED EMISSIONS (ABOVE 1GHZ) FOR FCC 15B

TEST DESCRIPTION

Method

These measurements have been performed according to ANSI C63.4-2014.

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).

* 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 = 100-400 cm above the floor with bore-sight movement.

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
- ☐ 1-18GHz

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 (1-6GHz); ± 5.2 dB (6-18GHz)

Instruments used during measurement

Instrument list: Antenna, Horn: ETS / 3117 (LR-1717) (01/2030)
EMI Receiver: R&S / ESU40 (LR-1639) (01/2026)
Preamplifier: ETS / 3117-PA (LR-1757) (12/2025)

Conformity

Verdict:

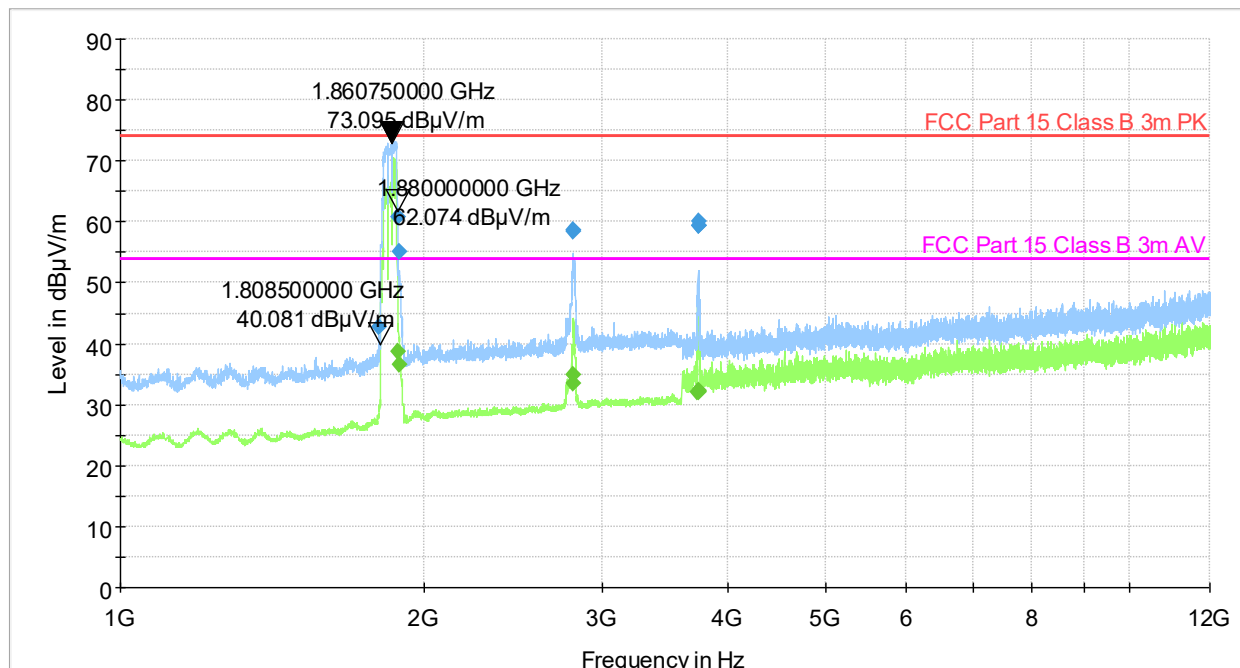
PASS

Test engineer:

Thanh Tran

EMISSION SPECTRUM (HORIZONTAL POLARIZATION)

Full Spectrum



— Preview Result 2-AVG
— FCC Part 15 Class B 3m AV
◆ Final_ResultAVG
— Preview Result 1-PK+
◆ Final_Result PK+
— FCC Part 15 Class B 3m PK

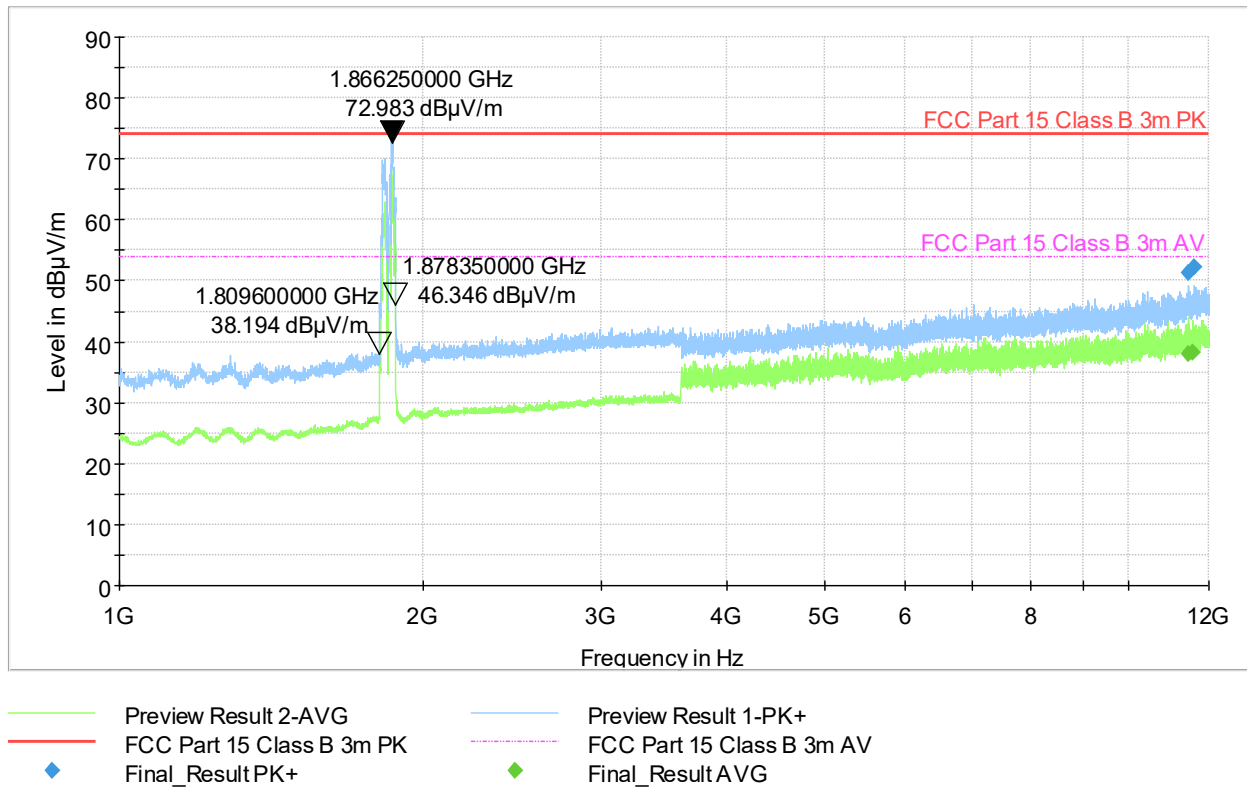
The frequency range 1805-1880MHz is LTE band 03 downlink.

MEASUREMENTS DATA

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1804.668800	42.67	---	74.00	31.33	15000.0	1000.000	100.0	H	322.0	-12.2
1881.100000	---	38.81	54.00	15.19	15000.0	1000.000	100.0	H	353.0	-11.6
1882.112800	60.73	---	74.00	13.27	15000.0	1000.000	100.0	H	268.0	-11.6
1890.940800	55.20	---	74.00	18.80	15000.0	1000.000	100.0	H	353.0	-11.5
1892.100000	---	36.56	54.00	17.44	15000.0	1000.000	100.0	H	353.0	-11.5
2803.986400	58.30	---	74.00	15.70	15000.0	1000.000	100.0	H	100.0	-7.6
2806.200000	---	33.39	54.00	20.71	15000.0	1000.000	100.0	H	353.0	-7.6
2812.250000	---	34.92	54.00	19.08	15000.0	1000.000	100.0	H	353.0	-7.6
2812.357600	58.57	---	74.00	15.43	15000.0	1000.000	100.0	H	346.0	-7.6
3733.500000	---	31.98	54.00	22.02	15000.0	1000.000	100.0	H	353.0	-4.1
3735.150000	---	32.38	54.00	21.62	15000.0	1000.000	100.0	H	353.0	-4.1
3735.209200	59.47	---	74.00	14.53	15000.0	1000.000	100.0	H	268.0	-4.1
3735.291600	59.99	---	74.00	18.01	15000.0	1000.000	100.0	H	288.0	-4.1
3743.950000	---	32.10	54.00	21.90	15000.0	1000.000	100.0	H	353.0	-4.0
3743.962000	59.46	---	74.00	14.54	15000.0	1000.000	100.0	H	268.0	-4.0

EMISSION SPECTRUM (VERTICAL POLARIZATION)

Full Spectrum



The frequency range 1805-1880MHz is LTE band 03 downlink.

MEASUREMENTS DATA

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
11444.023600	51.24	---	74.00	22.76	15000.0	1000.000	100.0	V	278.0	6.0
11445.600000	---	37.96	54.00	16.04	15000.0	1000.000	100.0	V	315.0	6.0
11582.550000	---	38.22	54.00	15.78	15000.0	1000.000	100.0	V	315.0	6.4
11608.710000	52.23	---	74.00	21.77	15000.0	1000.000	100.0	V	315.0	6.5

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: AMETEK / Dito (N-5035) (03/2025)

		Conformity	
Temperature:	21.79 °C	Verdict:	PASS
Humidity:	42.78 %RH	Test engineer:	Thanh Tran
Atmos. pressure:	991.0 hPA		

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
None-conductive surfaces	$\pm 2, \pm 4, \pm 8$	Air	10	B	A	PASS
LED, Button	$\pm 2, \pm 4, \pm 8$	Air	10	B	A	PASS
Screws	± 4	Contact	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, GF: AR / 120S1G4M3 (LR-1595) (N/A)
 Amplifier, RF: R&S / BBA150 (LR-1805) (N/A)
 Antenna, Log-periodic: Schwarzbeck / STLP 9129 (LR-1801) (N/A)
 Field probe: ETS / HI-6105 (LR-1756) (10/2026)
 Generator, RF: R&S / SMB100A (LR-1603) (01/2027)
 Power Sensor: R&S / NRP8SN (LR-1803) (01/2025)
 Power Sensor: R&S / NRP8SN (LR-1804) (01/2025)

Conformity

Verdict:

PASS

Test engineer:

Thanh Tran

DETAILED TEST LOG

Frequency range [MHz]	Field strength [V/m]	Polarization	Required Criteria	Complied Criteria	Result
80 - 1000	3	HOR	A	A	PASS
80 - 1000	3	VER	A	A	PASS
1000 - 6000	3	HOR	A	A	PASS
1000 - 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).

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: Current Transformer: EMTest / MC 2630 (LR-1618) (N/A)
Generator: EMTest / UCS 500 N7 (LR-1608) (06/2025)
Magnetic Coil: EMTest / MS100N (LR-1611) (N/A)
Motorized Variac: EMTest / MV2616 (LR-1610) (06/2025)

Conformity

Verdict: **PASS**

Test engineer: **Thanh Tran**

DETAILED TEST LOG

Axis [X/Y/Z]	Field Strength [A/m]	Field Frequency	Required Criteria	Complied Criteria	Result
X	3	AC 50Hz	A	A	PASS
Y	3	AC 50Hz	A	A	PASS
Z	3	AC 50Hz	A	A	PASS
X	3	AC 60Hz	A	A	PASS
Y	3	AC 60Hz	A	A	PASS
Z	3	AC 60Hz	A	A	PASS

OBSERVATIONS

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

Annexes

PHOTOS

Photographs of the test item(s) and the test setups for FCC part 15B are placed in an addendum to this report. The addendum is a separate file only linked to this report by its common report number.