EMC / EMI Test Report

As per

FCC Part 15 Subpart C 15.247, RSS-247

Unlicensed Intentional Radiators

on the

SmartRock® Long Range

Issued by:

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See Appendix A for full client & EUT details.

Testing Laboratory
Certificate #2955.19

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Report Scope

This report addresses the EMC verification testing and test results of the **SmartRock®**, Model: **Long Range** , herein referred to as EUT (Equipment Under Test). The EUT was tested for emissions against the following standards:

FCC Part 15, Subpart C 15.247 (select sections)

RSS-247 (select sections)

Test procedures, results, justifications, and engineering considerations, if any, follow later in this report.

For a more detailed list of the standards and the revision used, see the "Applicable Standards, Specifications and Methods" section of this report.

This report does not imply product endorsement by any government, accreditation agency, or TÜV SÜD Canada Inc.

Opinions or interpretations expressed in this report, if any, are outside the scope of TÜV SÜD Canada Inc. accreditations. Any opinions expressed do not necessarily reflect the opinions of TÜV SÜD Canada Inc., unless otherwise stated.

Summary

The results contained in this report relate only to the item(s) tested.

Equipment Under Test (EUT)	SmartRock® Long Range
FCC Certification #, FCC ID:	2AYDI-MURABZ
Industry Canada Certification #, IC:	26758-MURABZ
EUT passed all tests performed	Yes
Testing conducted by	Scott Drysdale

For testing dates, see 'Testing Environmental Conditions and Dates'.

Test Results Summary

Standard/ Method	Description	Criteria	Class / Level	Result
15.247 – RSS-247 (ANSI C63.10	EIRP & Radiated Emissions	N/A	Equal or less than previous certification[Note 1]	Pass
Overall Result				**Pass**

If the product as tested complies with the specification or requirement, the EUT is deemed to comply and is issued a 'PASS' grade. If not, 'FAIL' grade is issued.

Note 1: For tests not re-performed, and limit applied, see Notes, justifications and deviations

Notes, Justifications, or Deviations

The following justifications for tests not performed or deviations from the above listed specifications apply:

No power line conducted emissions test was evaluated on the EUT as the EUT is battery operated without provision for any connection to a charger or AC mains.

This test program is to incorporate W3538B0035 which has a maximum gain of -1.2dBi at 824 MHz – 960MHz. As this test program was for a different antenna type then was previously certified, with a rated antenna gain less than that previously certified, only EIRP of the fundamental and the unintentional emissions was deemed necessary, where the EIRP was to be below the calculated EIRP of the previous certification.

The module was tested at the low, middle and high channels with hopping of the 125 kHz channel bandwidth mode, at 902.3 MHz, 908.5 MHz, and 914.9 MHz respectively as that is the mode declared by the manufacturer that this product will be operated in.

The previously certified conducted values for low, middle and high channel were 18.73 dBm, 18.11 dBm and 17.86 dBm. With stated antenna maximum gain of 1.04 dBi, this correlates to an EIRP of 19.77 dBm, 19.15 dBm, 18.9 dBm. At a 3 meter distance this corresponds to field strengths of 114.97 dBuV/m, 114.35 dBuV/m and 114.1 dBuV/m. Accordingly, a worst case limit of 114.1 dBuV/m is applied for this C2PC.

Sample Calculation(s)

Radiated Emission Test

E-Field Level = Received Signal + Antenna Factor + Cable Loss – Pre-Amp Gain
E-Field Level = 50dBµV + 10dB/m + 2dB – 20dB
E-Field Level = 42dBµV/m

Margin = Limit – E-Field Level
Margin = 50dBµV/m – 42dBµV/m
Margin = 8.0 dB (pass)

Applicable Standards, Specifications and Methods

ANSI C63.4:2014	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10:2013	American National Standard For Testing Unlicensed Wireless Devices
CFR 47 FCC 15 Subpart C:2023	Code of Federal Regulations – Radio Frequency Devices, Intentional Radiators
FCC KDB 558074: 2017	FCC KDB 558074 Digital Transmission Systems, measurements and procedures
RSS-GEN Issue 5 2018	General Requirements and Information for the Certification of Radio Apparatus
RSS-247 Issue 3:2023	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
ISO/IEC 17025:2017	General Requirements for the Competence of Testing and Calibration Laboratories

Document Revision Status

Revision	Date	Description
000	June 19, 2024	Initial Draft Release
001	June 21, 2024	Signed release – minor typographical errors.
002	July 26, 2024	Added reference to antenna as per TCB request.

Definitions and Acronyms

The following definitions and acronyms are applicable in this report.
See also ANSI C63.14.

AM – Amplitude Modulation
LISN – Line Impedance Stabilization Network
NSA – Normalized Site Attenuation
N/A – Not Applicable
RF – Radio Frequency

AE – Ancillary Equipment. Equipment (apparatus), used in connection with a receiver or transmitter.

It is considered as an ancillary equipment (apparatus) if:

- The equipment is intended for use in conjunction with a receiver or transmitter to provide additional operational and/or control features to the radio equipment, (e.g. to extend control to another position or location); and
- The equipment cannot be used on a standalone basis to provide user functions independently of a receiver or transmitter; and
- The receiver or transmitter, to which it is connected, is capable of providing some intended operation such as transmitting and/or receiving without the ancillary equipment (i.e. it is not a sub-unit of the main equipment essential to the main equipment basic functions).

Portable Equipment – Radio and/or ancillary equipment intended for portable (e.g. handheld) operation, powered by its own integral battery.

Base Station (Fixed Use) Equipment – Radio and/or ancillary equipment intended for operation at a fixed location and powered directly or indirectly (e.g. via an AC/DC converter or power supply) by the AC mains network, or an extended local DC mains network.

Adaptive Equipment – Equipment operating in an adaptive mode. A mechanism by which equipment can adapt to its radio environment by identifying other transmissions present in the band.
Class A device – A device that is marketed for use in a commercial, industrial or business environment. A 'Class A' device should not be marketed for use by the general public. A 'Class A' device should contain a warning notice in the user manual stating that it could cause radio interference. For example: "**Warning**: Operation of this equipment in a residential environment could cause radio interference."

Class B device – A device that is marketed for use in a residential environment and may also be used in a commercial, business or industrial environments. NOTE: A residential environment is an environment where the use of broadcast radio and television receivers may be expected within a distance of 10m of the device concerned.

EMC – Electro-Magnetic Compatibility. The ability of an equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment.

EMI – Electro-Magnetic Immunity. The ability to maintain a specified performance when the equipment is subjected to disturbance (unwanted) signals of specified levels.

EUT – Equipment Under Test. A device or system being evaluated for compliance that is representative of a product to be marketed.

ITE – Information Technology Equipment - Has a primary function of entry, storage, display, retrieval, transmission, processing, switching, or control, of data and of telecommunication messages and which may be equipped with one or more terminal ports typically operated for information transfer.

Testing Facility

Testing for EMC on the EUT was carried out at TÜV SÜD Canada testing lab located in Kanata, Ontario. The testing lab has calibrated 3m semi-anechoic chambers which allow measurements on a EUT that has a maximum width or length of up to 2m and a height of up to 3m. The testing lab also has a calibrated 10m semi-anechoic chamber. The chambers are equipped with a turntable that is capable of testing devices up to 5000lb in weight and are equipped with a mast that controls the polarization and height of the antenna. Control of the mast occurs in the control room adjoining the shielded chamber. This facility is capable of testing products that are rated for single phase or 3-phase AC input and DC capability is also available. Radiated emission measurements are performed using a BiLog antenna and a Horn antenna where applicable.

Calibrations and Accreditations

The test facilities of TÜV SÜD Canada Inc are accredited by the American Association for Laboratory Accreditation (A2LA) to ISO/IEC 17025:2017 in accordance with the scope of accreditation outlined under A2LA Certificate number 2955.19.

A2LA Cert. No. 2955.19

The Canadian lab registration number associated with the TÜV SÜD test facilities is 24015 and CAB identifier CA4180.

Testing Environmental Conditions and Dates

Following environmental conditions were recorded in the facility during time of testing:

Date	Test	Initials	Temperature (ºC)	Humidity (%)	Pressure (kPa)
March 6 – 14, 2024	Radiated Emissions	SD	20-22	42-60	100-103

Detailed Test Result Section

Radiated Emissions

Purpose

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT does not exceed the limits listed below as defined in the applicable test standard, as measured from a receiving antenna. This helps protect broadcast radio services such as television, FM radio, pagers, cellular telephones, emergency services, and so on, from unwanted interference.

Limit and Method

The method is given in ANSI C 63.10

A worst case limit of 114.1 dBuV/m at 3 meters was applied to the intentional transmission as per the Notes, Justifications and Deviations section of this test report.

The limits are as defined in FCC Part 15, Section 15.209 and RSS GEN:

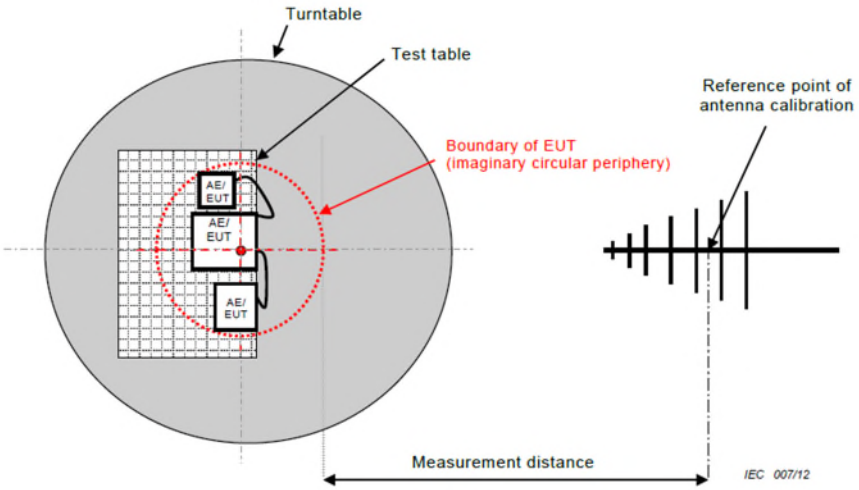
The limits, as defined in 15.247(d) for unintentional radiated emissions apply for those emissions that fall in the restricted bands, as defined in Section 15.205(a). These emissions must comply with the radiated emission limits specified in Section 15.209(a).

All unintentional emissions outside the restricted bands must also meet the 'Spurious Conducted Emissions' requirements of -30 dBc or the unintentional limits in 15.209. See also 'Spurious Conducted Emissions' for further details.

0.009 MHz – 0.490 MHz, 2400/F (kHz) uV/m at 300 m[1]
0.490 MHz – 1.705 MHz, 24000/F (kHz) uV/m at 30 m[1]
1.705 MHz – 30 MHz, 30 uV/m at 30 m[1]
30 MHz – 88 MHz, 100 uV/m (40.0 dBuV/m[1]) at 3 m
88 MHz – 216 MHz, 150 uV/m (43.5 dBuV/m[1]) at 3 m
216 MHz – 960 MHz, 200 uV/m (46.0 dBuV/m[1]) at 3 m
Above 960 MHz, 500 uV/m (54.0 dBuV/m[1]) at 3 m
Above 1000 MHz, 500 uV/m (54 dBuV/m[2]) at 3m
Above 1000 MHz, 500 uV/m (74 dBuV/m[3]) at 3m

[1]Limit is with Quasi Peak detector with bandwidths as defined in CISPR-16-1-1
[2]Limit is with 1 MHz measurement bandwidth and using an Average detector
[3]Limit is with 1 MHz measurement bandwidth and using a Peak detector

Typical Radiated Emissions Setup



Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is ±5.67dB for 30MHz – 1GHz and ±4.58dB for 1GHz – 18GHz with a 'k=2' coverage factor and a 95% confidence level.

Preliminary Graphs

Note the graphs shown below are for graphical illustration only. For final measurements with the appropriate detector, please refer to the final measurement table where applicable. The graph shown below is a maximized peak measurement graph, measured with a resolution bandwidth greater than the final required detector and over a full 0-360 rotation. This peaking process is done as a worst case measurement. This process enables the detection of frequencies of concern for final measurement, and provides considerable time savings.

In accordance with FCC Part 15, Subpart A, Section 15.33, the device was scanned to the 10^{th} harmonic (a minimum of a 9.15 GHz).

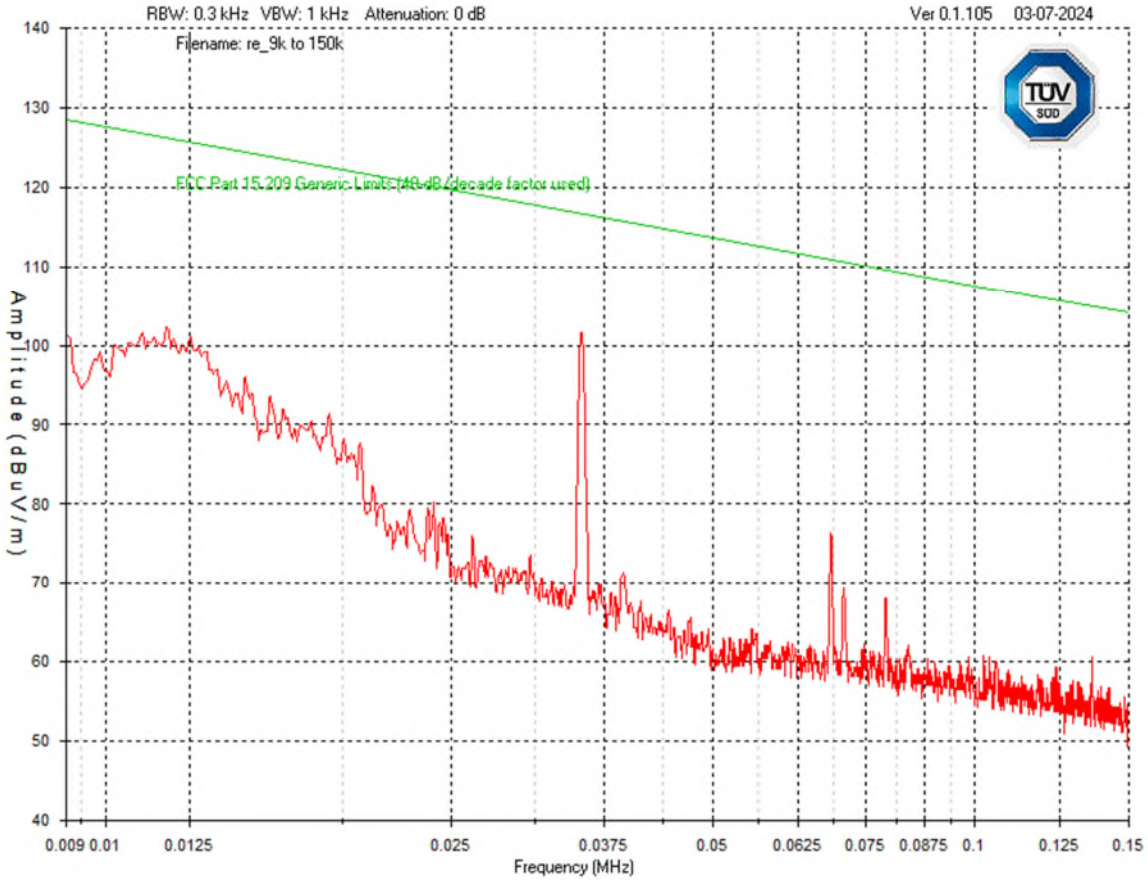
Devices scanned may be scanned at alternate test distances, and in accordance with FCC Part 15, Subpart A, Section 15.31, an extrapolation factor of 20 dB/decade was used above 30 MHz and 40 dB/decade below 30 MHz. For example for 1 meter measurements, an extrapolation factor 9.5 dB from 20 Log (1m / 3m) is applied.

The EUT was set to transmit at maximum power. Low, middle and high channels in each mode were measured; however the worst case or representative graphs are presented.

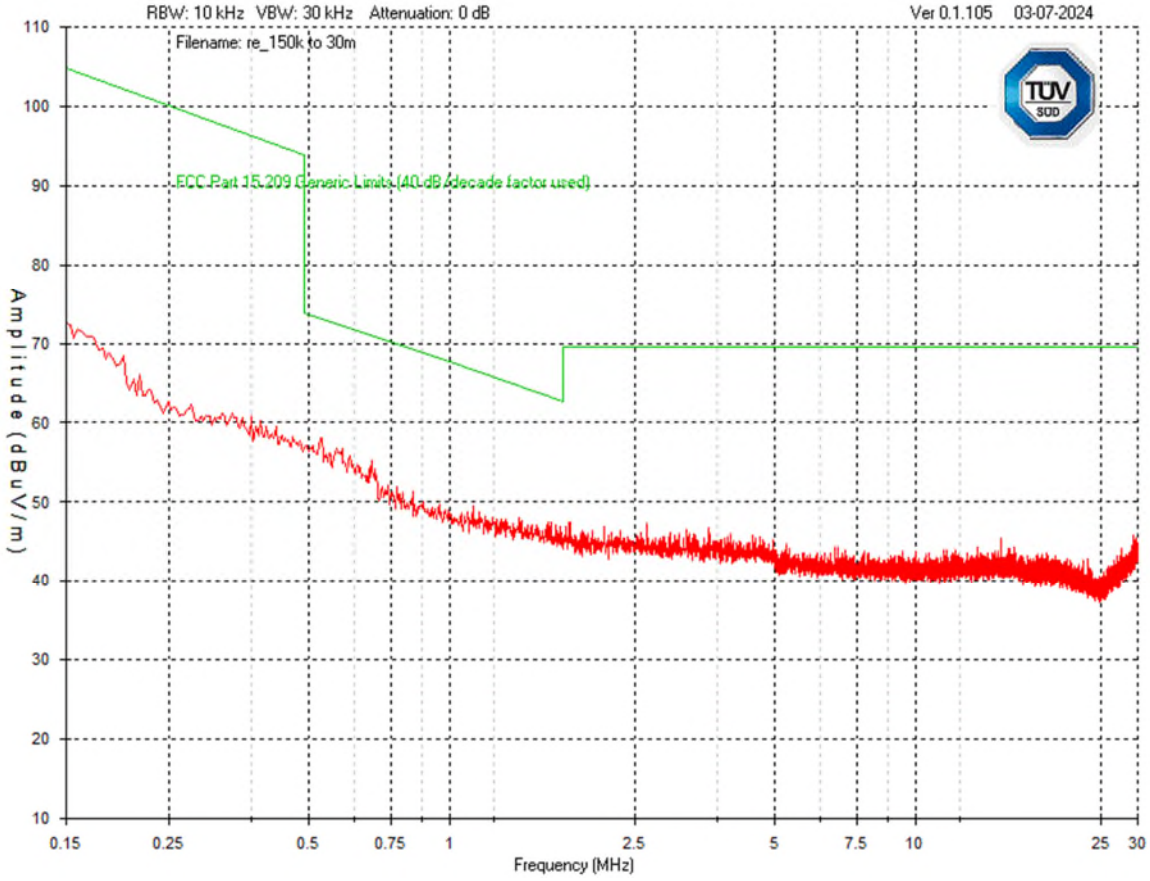
Band edge measure graphs are shown for illustrations purpose. No emissions were detected between 9kHz and 30 MHz and the noise floor of the instrumentation was below the applicable limit.

See final measurement section for all measurements.

9 kHz to 150 kHz.

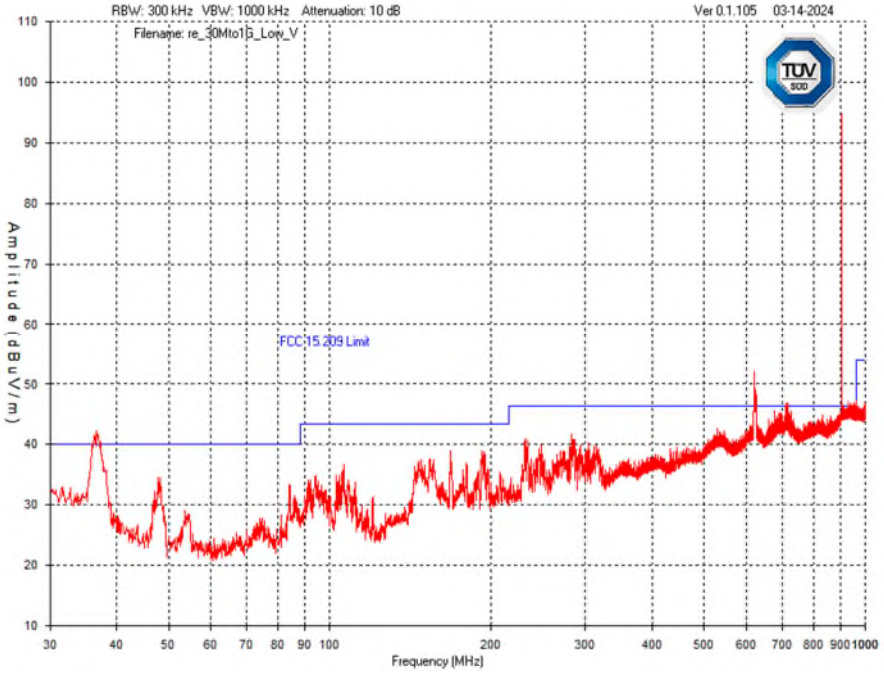


150 kHz to 30 MHz

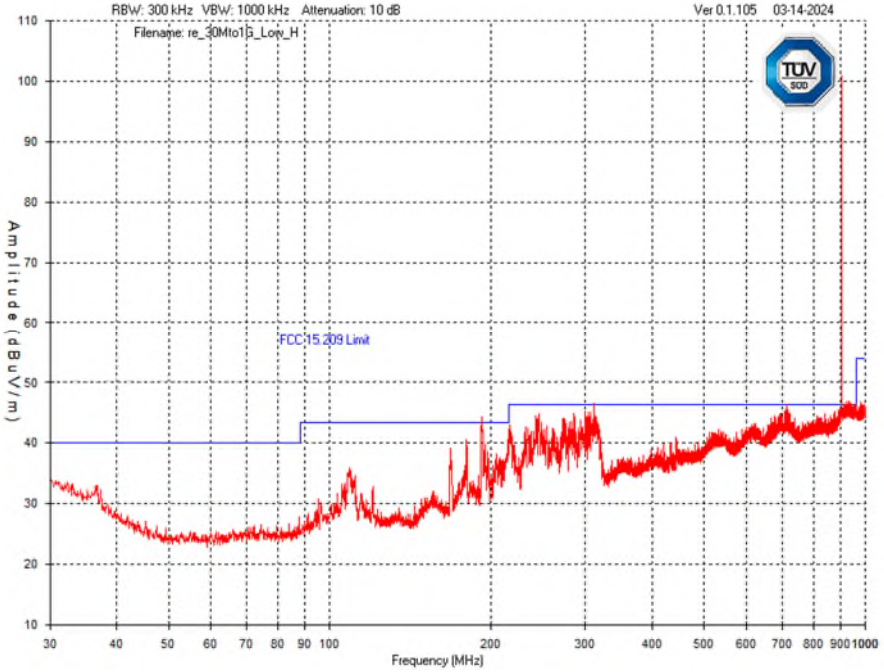


30 MHz to 1 GHz – Peak Radiated Emissions Graphs

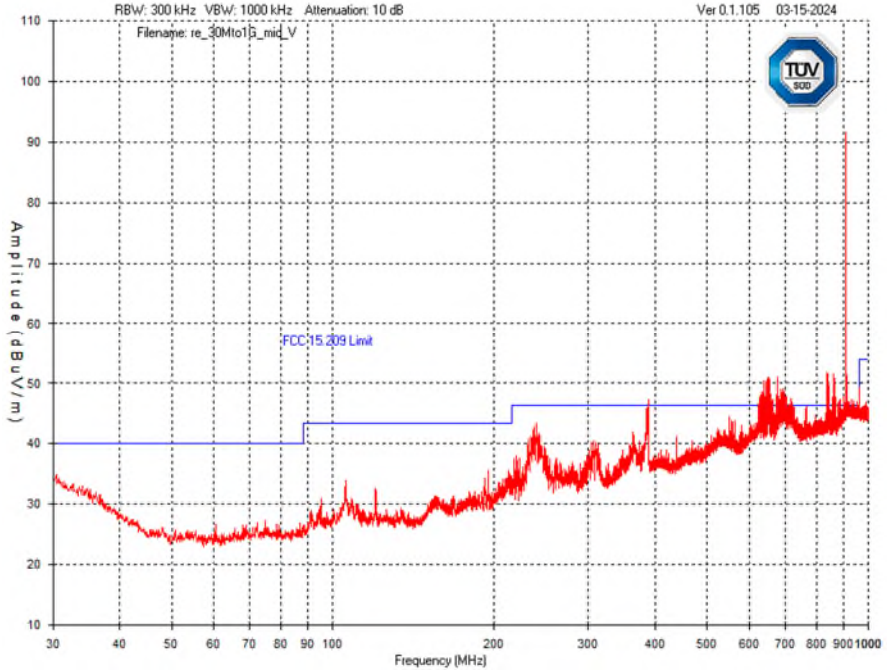
Low channel Vertical



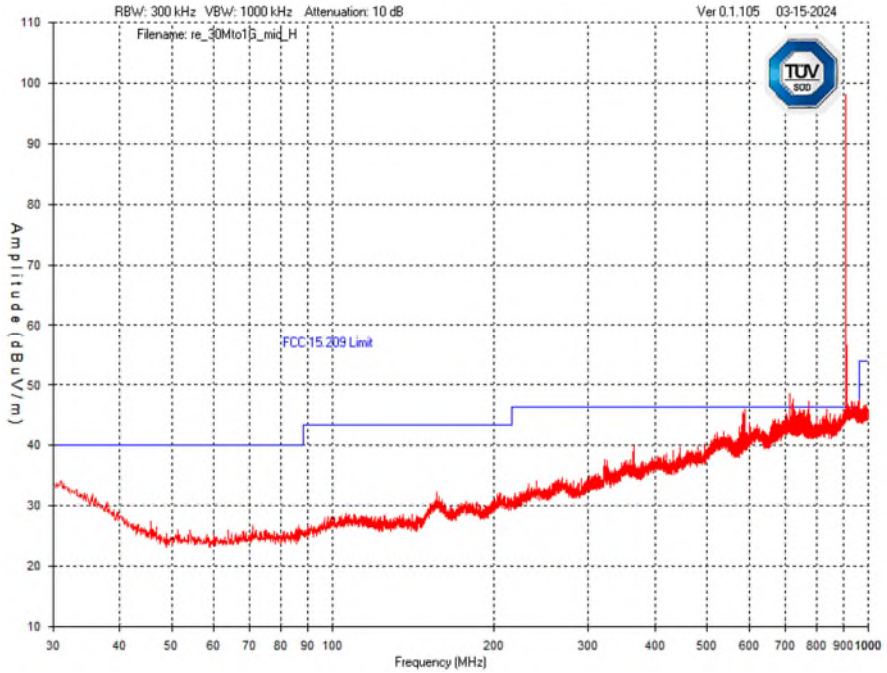
Low channel Horizontal



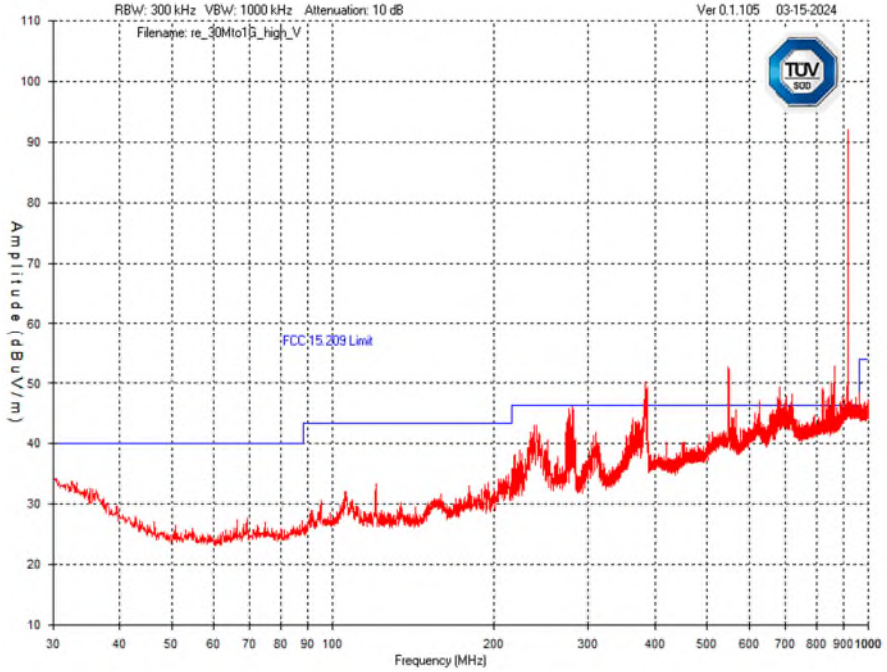
Mid channel Vertical



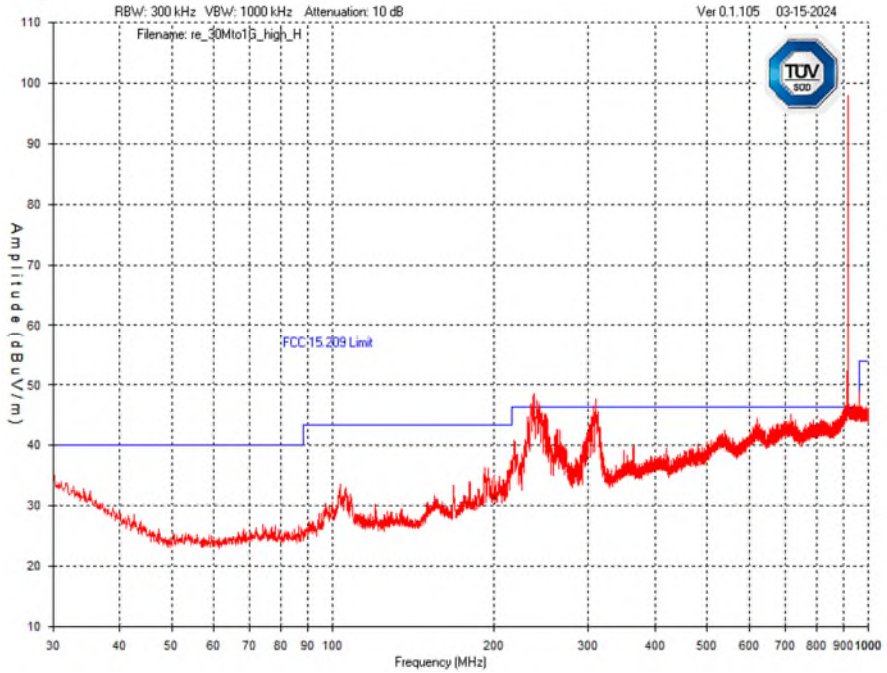
Mid channel Horizontal



High channel Vertical

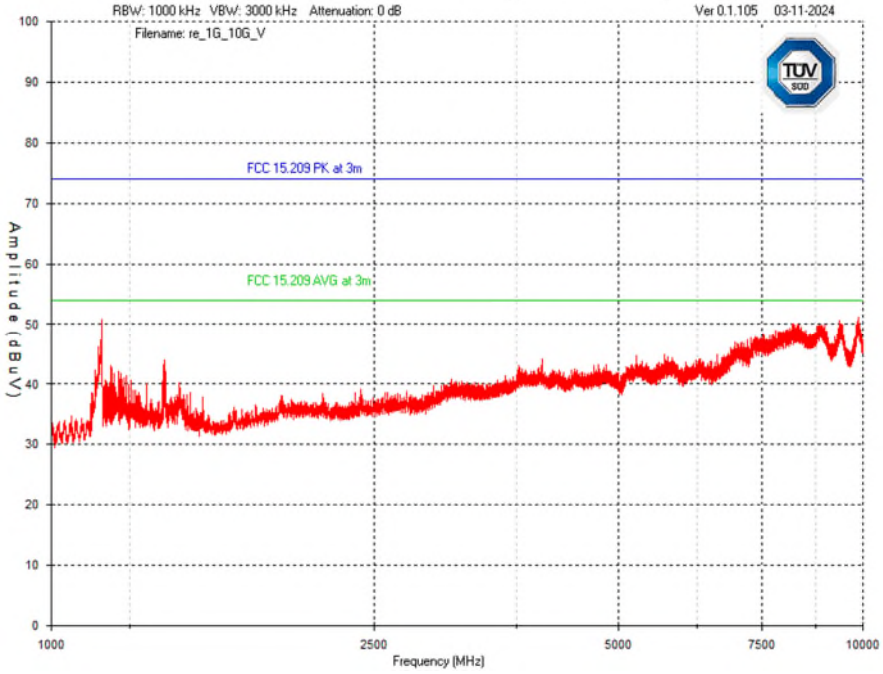


High channel Horizontal

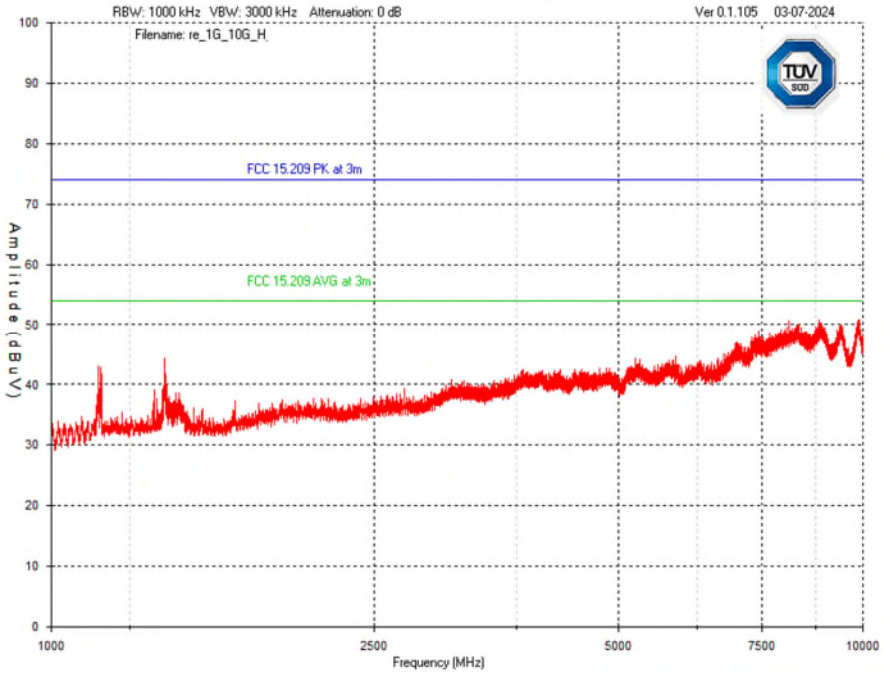


1 GHz to 10 GHz – Peak Radiated Emissions Graphs

Vertical (Mid channel as worst case / representative)



Horizontal (Mid channel as worst case / representative)



Final Measurements and Results

The EUT passed the limits. Low, middle and high bands as measured.

In accordance with 15.247(d), only frequencies with a peak emission exceeding the 15.209 limit that occur within the bands listed in 15.205, need to be verified with a final detector against the 15.209 limits. Emission outside the restricted bands were measured for information purpose and noted whether the 15.209 limits or the -30 dBc requirement was applied.

The measurements were maximized by rotating the turn table over a full 0-360 rotation and the antenna height was varied from 1 m to 4 m.

Where the device complied with the Quasi-Peak or Average limit, and was measured with a Peak detector, it was deemed to have met the requirement and peak data is compared to the applicable limit.

All emissions from 9 kHz to 30 MHz were instrument noise floor of the measurement instrument and below the applicable limit. No emissions were found from the EUT in this frequency range.

All emissions above 18 GHz were instrument noise floor of measurement instrument and below the applicable limit. No emissions were found from the EUT in this frequency range.

Frequency (MHz)	Detector	Received Signal (dBµV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-Amp (dB)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Test Result
Vertical Antenna Polarization – Low channel									
902.3	PK	85.5	28.1	8.6	-27.3	94.9	114.1	19.2	Pass
620.253	QP	37.6	25.9	7.8	-27.3	44	46.4	2.4	Pass
36.6997	QP	37.5	16.3	5	-27	31.8	40	8.2	Pass
714.243	QP	31.9	26.7	8	-27.6	39	46.4	7.4	Pass
Horizontal Antenna Polarization – Low channel									
902.3	PK	92.5	28.1	8.6	-27.3	101.9	114.1	12.2	Pass
191.958	QP	41.2	14.2	6.2	-27.3	34.3	43.5	9.2	Pass
311.679	QP	38.3	18.7	6.8	-27.3	36.5	46.4	9.9	Pass
711.816	QP	31.2	26.7	8	-27.6	38.3	46.4	8.1	Pass
Vertical Antenna Polarization – Mid channel									
908.5	PK	81.9	28.4	8.6	-27.3	91.6	114.1	22.5	Pass
836.78	QP	34.6	26.5	8.4	-27.7	41.8	46.4	4.6	Pass
861.928	QP	34.3	26.4	8.4	-27.6	41.5	46.4	4.9	Pass
651.616	QP	35.9	24.6	7.8	-27.4	40.9	46.4	5.5	Pass
Horizontal Antenna Polarization – Mid Channel									
908.5	PK	88.4	28.4	8.6	-27.3	98.1	114.1	16	Pass
712.593	QP	34.5	26.7	8	-27.6	41.6	46.4	4.8	Pass
775.22	QP	34.1	26.3	8.2	-27.8	40.8	46.4	5.6	Pass
587.823	QP	31.3	24.2	7.6	-27.2	35.9	46.4	10.5	Pass
Vertical Antenna Polarization – High channel									
914.9	PK	82.1	28.6	8.6	-27.3	92	114.1	22.1	Pass
865.423	QP	35.6	26.5	8.4	-27.5	43	46.4	3.4	Pass
547.819	QP	34.5	24.4	7.6	-27.2	39.3	46.4	7.1	Pass
383.531	QP	41.5	20.7	7.1	-27.3	42	46.4	4.4	Pass
Horizontal Antenna Polarization – High Channel									
914.9	PK	88.1	28.6	8.6	-27.3	98	114.1	16.1	Pass
237.302	QP	42	17.4	6.5	-27.3	38.6	46.4	7.8	Pass
309.64	QP	40.5	18.7	6.8	-27.3	38.7	46.4	7.7	Pass
240.215	QP	41.5	17.4	6.6	-27.3	38.2	46.4	8.2	PAss

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	ESU 40	Rohde & Schwarz	Jan 17, 2024	Jan 17, 2025	SSG013672
Pre-Amp	LNA-1450	RF Bay	Sept 16, 2022	Sept 15, 2024	SSG013864
Loop Antenna	EM 6879	Electro-Metrics	May 29, 2023	May 29, 2025	LAVE4040
Bilog Antenna	3142-E	ETS Lindgren	June 16, 2023	June 16, 2025	LAVE4002
RF Amplifier (30-1000MHz)	Hewlett Packard	8447D	April 26, 2023	April 26, 2025	SSG013045
Pre-Amplifier (1-18GHz) (A7)	BNR	LNA	April 25, 2023	April 25, 2025	SSG012594
Coaxial Cable (1-18 GHz)	Micro-Coax	UFA 210B-1-1500-504504	Feb 1, 2024	Feb 1, 2025	SSG012376
Horn Antenna 3MCH 00003	ETS-Lindgren	3117	May 20, 2024	May 20, 2025	LAVE04211

Appendix A – EUT & Client Provided Details

General EUT Description

Client Details	
Organization / Address	Giatec Scientific Inc.
EUT (Equipment Under Test) Details	
EUT Name	SmartRock® Long Range
EUT revision	2.0
Software version	3.0
Equipment category	IoT sensor for construction industry
EUT is powered using	2x 3.6V Coin cells
Modes of operation	Off, Normal operation
Customer to setup EUT on site?	Yes
EUT setup time (min)	~2 minutes
Frequency of all clocks present in EUT	LoRa MCU includes the following: 32MHz clock, 32.768 kHz clock
Dimensions of product	L : 80 mm W: 42mm H : 30 mm
Other notes	N/A

Appendix B – EUT, Peripherals, and Test Setup Photos

Note: For test setup photos and EUT photos refer to separate photo exhibits.