



Choose Scandinavian trust

RADIO TEST REPORT – 448856-3TRFWL

Type of assessment:

Final product testing

Applicant:

Octo Telematics Spa
Via Vincenzo Lamaro, 5
00173 -Roma - Italy

Product:

Tracking device for car-sharing

Model:

OCTO SharePro 4 GPS40000

Model variant(s):

OCTO SharePro 4 R GPS41000

FCC ID:

2AHR8-GPS4X0

Specifications:

- ◆ FCC 47 CFR Part 15 Subpart C, §15.247

Date of issue: September 28, 2021

D. Guarnone

Tested by

P. Barbieri

Reviewed by

Signature

Signature

This test report shall not be partially reproduced without the prior written consent of Nemko S.p.A. The phase of sampling of equipment under test is carried out by the customer. Results indicated in this test report refer exclusively to the tested samples and apply to the sample as received. This Test Report, when bearing the Nemko name and logo is only valid when issued by a Nemko laboratory, or by a laboratory having special agreement with Nemko.
Doc. n. TRF001; Rev. 0; Date: 2020-11-30

Lab locations

Company name	Nemko S.p.A
Address	Via del Carroccio, 4
City	Biassono
Province	MB
Postal code	20053
Country	Italy
Telephone	+39 039 2201201
Facsimile	+39 039 2201221
Website	www.nemko.com
Site number	FCC: 682159 (10 m semi anechoic chamber)

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contained in this report are within Nemko S.p.A.. ISO/IEC 17025 accreditation.

Copyright notification

This test report may not be partially reproduced, except with the prior written permission of Nemko Spa. The test report merely corresponds to the tested sample. The phase of sampling / collection of equipment under test is carried out by the customer

Table of Contents

Table of Contents	3
Section 1 Report summary	4
1.1 Test specifications	4
1.2 Test methods	4
1.3 Exclusions	4
1.4 Statement of compliance	4
1.5 Test report revision history	4
Section 2 Engineering considerations	5
2.1 Modifications incorporated in the EUT for compliance	5
2.2 Technical judgment	5
2.3 Deviations from laboratory tests procedures	5
Section 3 Test conditions	6
3.1 Atmospheric conditions	6
3.2 Power supply range	6
Section 4 Measurement uncertainty	7
4.1 Uncertainty of measurement	7
Section 5 Information provided by the applicant	8
5.1 Disclaimer	8
5.2 Applicant/Manufacturer	8
5.3 EUT information	8
5.4 Radio technical information	9
5.5 EUT setup details	9
Section 6 Summary of test results	12
6.1 Testing location	12
6.2 Testing period	12
6.3 Sample information	12
6.4 FCC Part 15 Subpart A and C, general requirements test results	12
6.5 FCC Part §15.247 test results for frequency hopping spread spectrum systems (FHSS)	12
6.6 FCC Part §15.247 test results for digital transmission systems (DTS)	13
Section 7 Test equipment	14
7.1 Test equipment list	14
Section 8 Testing data	15
8.1 Variation of power source	15
8.2 Number of frequencies	16
8.3 Antenna requirement	18
8.4 Minimum 6 dB bandwidth for DTS systems	19
8.5 Transmitter output power and e.i.r.p. requirements for DTS in 2.4 GHz	26
8.6 Spurious (out-of-band) unwanted emissions	32
8.7 Power spectral density for digitally modulated devices	61
Section 9 EUT photos	66
9.1 External photos	66
9.2 Set-up photos	69

Section 1 Report summary

1.1 Test specifications

FCC 47 CFR Part 15, Subpart C, Clause 15.247	Operation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–585 MHz
--	---

1.2 Test methods

558074 D01 15.247 Meas Guidance v05r02 (April 2, 2019)	Guidance for compliance measurements on digital transmission system, frequency hopping spread spectrum system, and hybrid system devices operating under section 15.247 of the FCC rules.
DA 00-705, Released March 30, 2000	Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems
ANSI C63.10 v2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

1.3 Exclusions

None

1.4 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was performed against all relevant requirements of the test standard except as noted in section 1.3 above. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

See "Summary of test results" for full details.

1.5 Test report revision history

Table 1.5-1: Test report revision history

Revision #	Date of issue	Details of changes made to test report
448856-1TRFWL	August 31, 2021	Original report issued
448856-3TRFWL	September 28, 2021	Revised report issued, corrected typing errors

Section 2 Engineering considerations

2.1 Modifications incorporated in the EUT for compliance

There were no modifications performed to the EUT during this assessment.

2.2 Technical judgment

None

2.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 3 Test conditions

3.1 Atmospheric conditions

In the laboratory, the following *ambient* conditions are respected for each test reported below:

Temperature	18 – 33 °C
Relative humidity	25 – 70 %
Air pressure	860 – 1060 mbar

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

The following instruments are used to monitor the environmental conditions:

Equipment	Manufacturer	Model no.	Asset no.	Cal date	Next cal.
Thermo-hygrometer data loggers	Testo	175-H2	20012380/305	12/2020	12/2022
Thermo-hygrometer data loggers	Testo	175-H2	38203337/703	12/2020	12/2022
Barometer	Castle	GPB 3300	072015	03/2021	03/2022

3.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages $\pm 5\%$, for which the equipment was designed.

Section 4 Measurement uncertainty

4.1 Uncertainty of measurement

The measurement uncertainty was calculated for each test and quantity listed in this test report, according to CISPR 16-4-2 and other specific test standard and is documented in Nemko Spa working manual WML1002.

The assessment of conformity for each test performed on the equipment is performed not taking into account the measurement uncertainty. The two following possible verdicts are stated in the report:

P (Pass) - The measured values of the equipment respect the specification limit at the points tested. The specific risk of false accept is up to 50% when the measured result is close to the limit.

F (Fail) - One or more measured values of the equipment do not respect the specification limit at the points tested. The specific risk of false reject is up to 50% when the measured result is close to the limit.

Hereafter Nemko's measurement uncertainties are reported:

EUT	Type	Test	Range	Measurement Uncertainty	Notes
Transmitter	Conducted	Frequency error	0.001 MHz ÷ 40 GHz	0.08 ppm	(1)
			0.009 MHz ÷ 30 MHz	1.1 dB	(1)
		Carrier power RF Output Power	30 MHz ÷ 18 GHz	1.5 dB	(1)
			18 MHz ÷ 40 GHz	3.0 dB	(1)
			40 MHz ÷ 140 GHz	5.0 dB	(1)
		Adjacent channel power	1 MHz ÷ 18 GHz	1.4 dB	(1)
			0.009 MHz ÷ 18 GHz	3.0 dB	(1)
		Conducted spurious emissions	18 GHz ÷ 40 GHz	4.2 dB	(1)
			40 GHz ÷ 220 GHz	6.0 dB	(1)
		Intermodulation attenuation	1 MHz ÷ 18 GHz	2.2 dB	(1)
		Attack time – frequency behaviour	1 MHz ÷ 18 GHz	2.0 ms	(1)
		Attack time – power behaviour	1 MHz ÷ 18 GHz	2.5 ms	(1)
		Release time – frequency behaviour	1 MHz ÷ 18 GHz	2.0 ms	(1)
		Release time – power behaviour	1 MHz ÷ 18 GHz	2.5 ms	(1)
		Transient behaviour of the transmitter – Transient frequency behaviour	1 MHz ÷ 18 GHz	0.2 kHz	(1)
		Transient behaviour of the transmitter – Power level slope	1 MHz ÷ 18 GHz	9%	(1)
		Frequency deviation - Maximum permissible frequency deviation	0.001 MHz ÷ 18 GHz	1.3%	(1)
	Radiated	Frequency deviation - Response of the transmitter to modulation frequencies above 3 kHz	0.001 MHz ÷ 18 GHz	0.5 dB	(1)
		Dwell time	-	3%	(1)
		Hopping Frequency Separation	0.01 MHz ÷ 18 GHz	1%	(1)
		Occupied Channel Bandwidth	0.01 MHz ÷ 18 GHz	2%	(1)
		Modulation Bandwidth	0.01 MHz ÷ 18 GHz	2%	(1)
		Radiated spurious emissions	0.009 MHz ÷ 26.5 GHz	6.0 dB	(1)
			26.5 GHz ÷ 66 GHz	8.0 dB	(1)
	Effective radiated power transmitter		66 GHz ÷ 220 GHz	10 dB	(1)
			10 kHz ÷ 26.5 GHz	6.0 dB	(1)
			26.5 GHz ÷ 66 GHz	8.0 dB	(1)
			66 GHz ÷ 220 GHz	10 dB	(1)

NOTES:

(1) The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2$, which for a normal distribution corresponds to a coverage probability of approximately 95 %

Section 5 Information provided by the applicant

5.1 Disclaimer

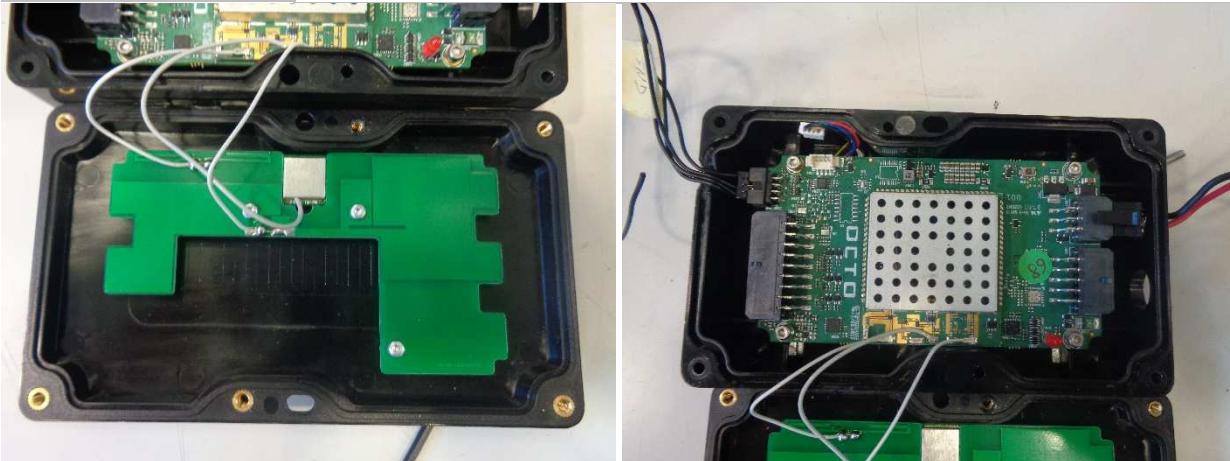
This section contains information provided by the applicant and has been utilized to support the test plan. Inaccurate information provided by the applicant can affect the validity of the results contained within this test report. Nemko accepts no responsibility for the information contained within this section and the impact it may have on the test plan and resulting measurements.

5.2 Applicant/Manufacturer

Applicant name	Octo Telematics Spa
Applicant address	Via Vincenzo Lamaro, 51 00173 -Roma - Italy
Manufacture name	Octo Telematics Spa
Manufacture address	Via Vincenzo Lamaro, 51 00173 -Roma - Italy

5.3 EUT information

Product	Tracking device
Model	OCTO SharePro 4
Serial number	4366730002 assigned by Nemko
Power supply requirements	Vehicle battery (12 Vdc)
Product description and theory of operation	The EUT is a Tracking device for car-sharing for vehicular application, supplied by the vehicle battery. It's provided with a Bluetooth radio module FTACVNRB for data exchange with another device and a LTE radio module u-blox model SARA-R412M-02B Revision: M0.11.01, SVN: 06, IMEI: 35467909289856 for the communication with a remote server.



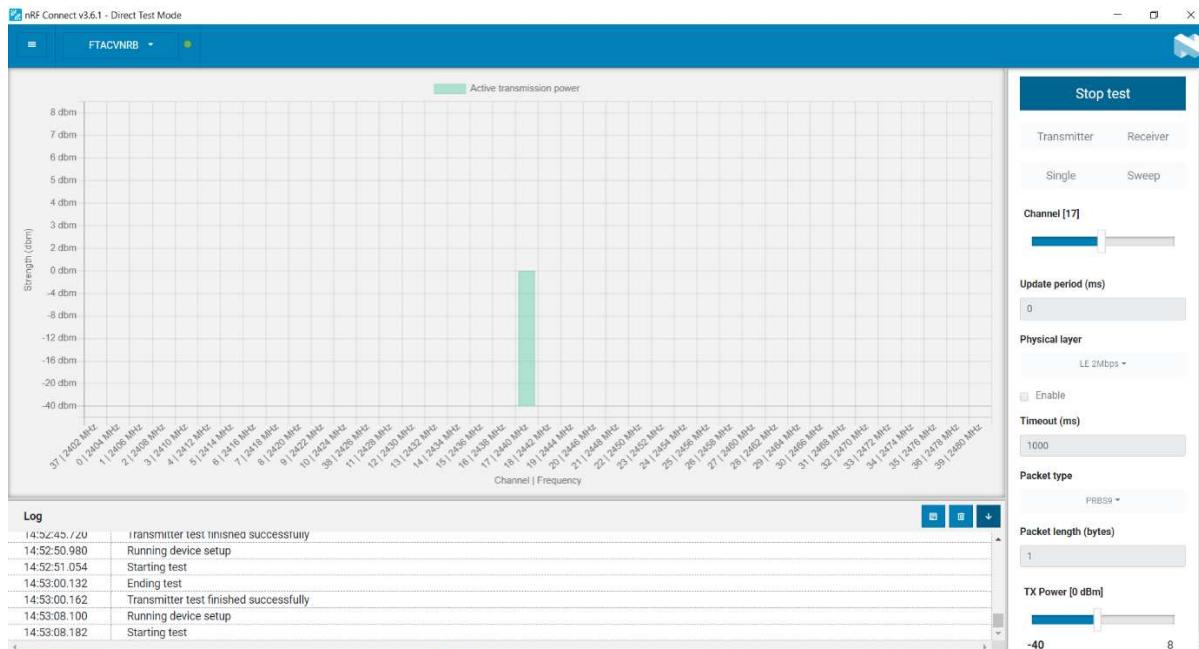
5.4 Radio technical information

Category of Wideband Data	<input type="checkbox"/> Frequency Hopping Spread Spectrum (FHSS) equipment
Transmission equipment	<input checked="" type="checkbox"/> Other types of Wideband Data Transmission equipment (e.g. DSSS, OFDM, etc.).
Frequency band	2400–2483.5 MHz
Frequency Min (MHz)	2402 MHz
Frequency Max (MHz)	2480 MHz
Channel numbers	40
RF power Max (W), Conducted	2.6 mW (4.15 dBm)
Field strength, dB μ V/m @ 3 m	99.35
Measured BW (kHz), 99% OBW	1077 kHz
Type of modulation	BLE (GFSK)
Emission classification	F1D
Transmitter spurious, dB μ V/m @ 3 m	62.8 dB μ V/m @ 7439.5MHz (Average)
Antenna information	Chip antenna type Pulse W3008, 1.1 dBi gain

5.5 EUT setup details

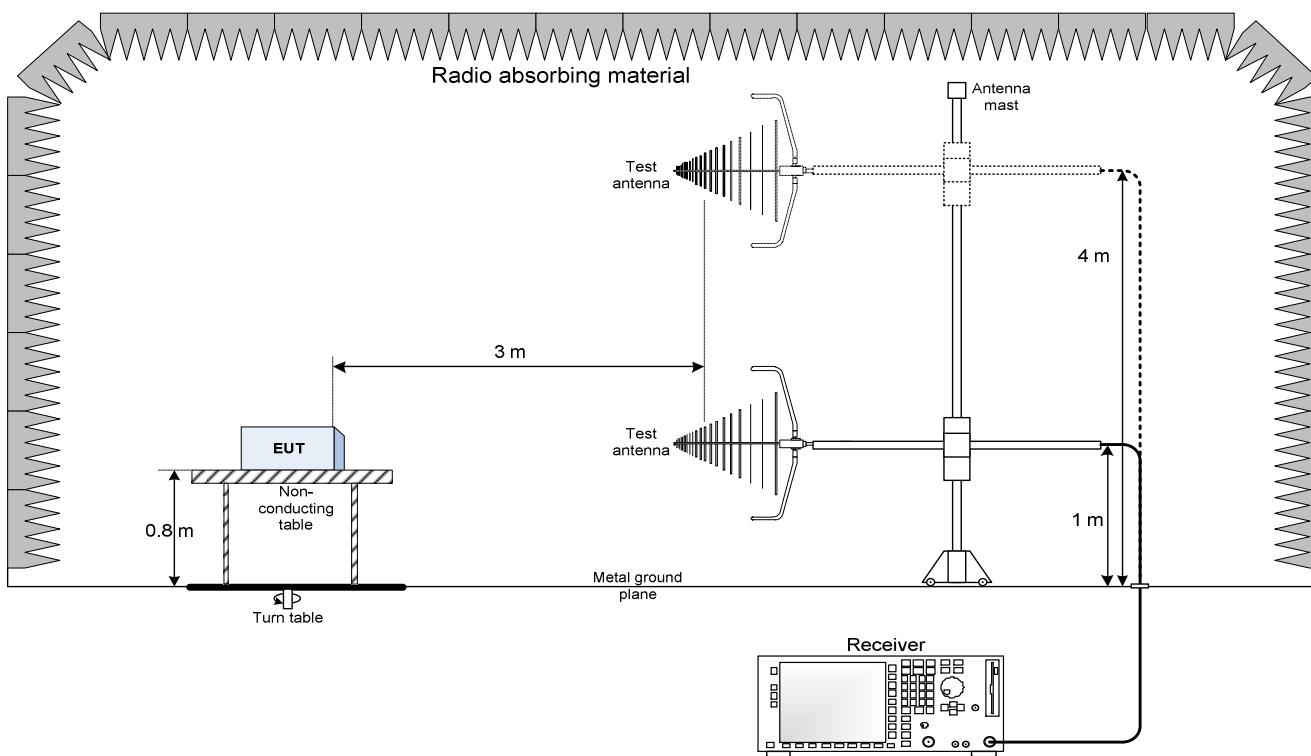
5.5.1 Radio exercise details

Operating conditions	To put the EUT in continuous transmission the nRF Connect v3.6.1 tool has been used
Transmitter state	Transmitter set into continuous mode.



5.5.2 EUT setup configuration
Table 5.5-1: EUT interface ports

Description	Qty.
DC power port with four wires cable connected to an external DC power source	1
USB port with standard cable (used only for programming the EUT) connected to a PC	1


Figure 5.5-1: Radiated testing block diagram below 1 GHz with sample 4318570001

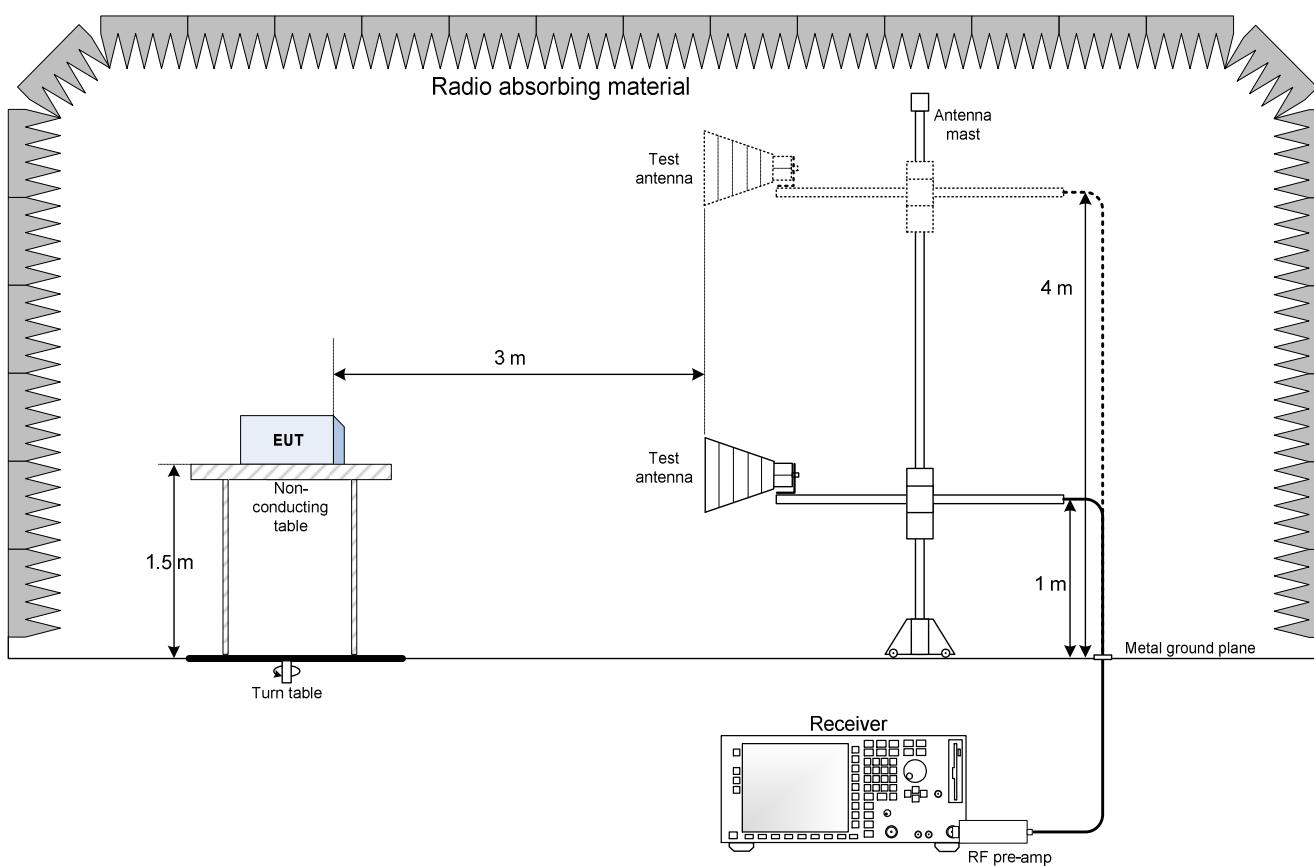


Figure 5.5-2: Radiated testing block diagram below 1 GHz with sample 4318570001

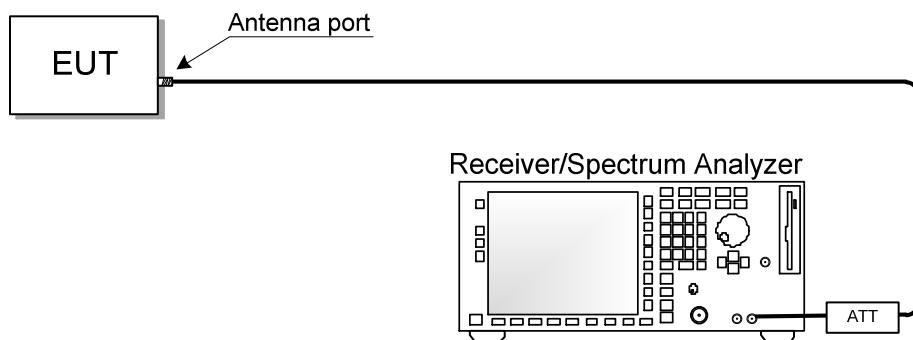


Figure 5.5-3: Antenna port testing block diagram with sample 4318570002 (temporary antenna connector provided by the manufacturer)

Section 6 Summary of test results

6.1 Testing location

Test location (s)	Nemko Spa Via del Carroccio, 4 – 20053 Biassono (MB) - Italy
-------------------	---

6.2 Testing period

Test start date	April 30, 2021	Test end date	August 31, 2021
-----------------	----------------	---------------	-----------------

6.3 Sample information

Receipt date	April 30, 2021	Nemko sample ID number(s)	4366730002
--------------	----------------	---------------------------	------------

6.4 FCC Part 15 Subpart A and C, general requirements test results

Table 6.4-1: FCC general requirements results

Part	Test description	Verdict
§15.207(a)	Conducted limits	Not applicable
§15.31	Variation of power source	Pass
§15.31(m)	Number of tested frequencies	Pass
§15.203	Antenna requirement	Pass

Notes: The EUT is supplied by a vehicle battery

6.5 FCC Part §15.247 test results for frequency hopping spread spectrum systems (FHSS)

Table 6.5-1: FCC FHSS requirements results

Part	Test description	Verdict
§15.247(a)(1)(i)	Requirements for operation in the 902–928 MHz band	Not applicable
§15.247(a)(1)(ii)	Requirements for operation in the 5725–5850 MHz band	Not applicable
§15.247(a)(1)(iii)	Requirements for operation in the 2400–2483.5 MHz band	Not applicable
§15.247(b)(1)	Maximum peak output power in the 2400–2483.5 MHz band and 5725–5850 MHz band	Not applicable
§15.247(b)(2)	Maximum peak output power in the 902–928 MHz band	Not applicable
§15.247(1)	Fixed point-to-point operation with directional antenna gains greater than 6 dBi	Not applicable
§15.247(2)	Transmitters operating in the 2400–2483.5 MHz band that emit multiple directional beams	Not applicable
§15.247(d)	Spurious emissions	Not applicable
§15.247(f)	Time of occupancy for hybrid systems	Not applicable

Notes: --

6.6 FCC Part §15.247 test results for digital transmission systems (DTS)

Table 6.6-1: FCC DTS requirements results

Part	Test description	Verdict
§15.247(a)(2)	Minimum 6 dB bandwidth	Pass
§15.247(b)(3)	Maximum peak output power in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands	Pass
§15.247I(1)	Fixed point-to-point operation with directional antenna gains greater than 6 dBi	Not applicable
§15.247I(2)	Transmitters operating in the 2400–2483.5 MHz band that emit multiple directional beams	Not applicable
§15.247(d)	Spurious emissions	Pass
§15.247I	Power spectral density	Pass
§15.247(f)	Time of occupancy for hybrid systems	Not applicable

Notes:

--

Section 7 Test equipment

7.1 Test equipment list

Table 7.1-1: Equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
EMI receiver (20 Hz ÷ 8 GHz)	Rohde & Schwarz	ESU8	100202	08/2021	08/2022
EMI receiver (2 Hz ÷ 44 GHz)	Rohde & Schwarz	ESW44	101620	08/2021	08/2022
Spectrum Analyzer (2 Hz ÷ 43 GHz)	Rohde & Schwarz	FSW43	101767	01/2021	01/2022
Trilog Antenna (30 MHz ÷ 7 GHz)	Schwarzbeck	VULB 9162	9162-025	07/2021	07/2024
Bilog antenna (1 ÷ 18 GHz)	Schwarzbeck	STLP 9148	9148-123	07/2021	07/2024
Horn Antenna (4 ÷ 40 GHz)	RFSpin	DRH40	061106A40	04/2020	04/2023
Preamplifier (1 ÷ 18 GHz)	Schwarzbeck	BBV 9718C	00121	01/2021	01/2022
Preamplifier (18 ÷ 40 GHz)	Sage	STB-1834034030-KFKF-L1	18490-01	03/2021	03/2022
Controller	Maturo	FCU3.0	10041	NCR	NCR
Tilt antenna mast	Maturo	TAM4.0-E	10042	NCR	NCR
Turntable	Maturo	TT4.0-5T	2.527	NCR	NCR
Semi-anechoic chamber	Nemko	10m semi-anechoic chamber	530	09/2019	09/2021
Shielded room	Siemens	10m control room	1947	NCR	NCR

Notes: NCR - no calibration required, VOU - verify on use

Section 8 Testing data

8.1 Variation of power source

8.1.1 References, definitions and limits

FCC §15.31 (e):

For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

8.1.2 Test summary

Verdict	Pass		
Tested by	D. Guarnone	Test date	April 30, 2021

8.1.3 Observations, settings and special notes

The testing was performed as per ANSI C63.10 Section 5.13.

- a) Where the device is intended to be powered from an external power adapter, the voltage variations shall be applied to the input of the adapter provided with the device at the time of sale. If the device is not marketed or sold with a specific adapter, then a typical power adapter shall be used.
- b) For devices, where operating at a supply voltage deviating $\pm 15\%$ from the nominal rated value may cause damages or loss of intended function, test to minimum and maximum allowable voltage per manufacturer's specification and document in the report.
- c) For devices with wide range of rated supply voltage, test at 15% below the lowest and 15% above the highest declared nominal rated supply voltage.
- d) For devices obtaining power from an input/output (I/O) port (USB, firewire, etc.), a test jig is necessary to apply voltage variation to the device from a support power supply, while maintaining the functionalities of the device.

For battery-operated equipment, the equipment tests shall be performed using a variable power supply.

8.1.4 Test data

EUT Power requirements:

If EUT is an AC or a DC powered, was the noticeable output power variation observed?

AC DC Battery

YES NO N/A

If EUT is battery operated, was the testing performed using fresh batteries?

YES NO N/A

If EUT is rechargeable battery operated, was the testing performed using fully charged batteries?

YES NO N/A

8.2 Number of frequencies

8.2.1 References, definitions and limits

FCC §15.31:

(m) Measurements on intentional radiators or receivers shall be performed and, if required, reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table.

RSS-Gen, Clause 6.9:

Except where otherwise specified, measurements shall be performed for each frequency band of operation for which the radio apparatus is to be certified, with the device operating at the frequencies in each band of operation shown in table below. The frequencies selected for measurements shall be reported in the test report.

Table 8.2-1: Frequency Range of Operation

Frequency range over which the device operates (in each band)	Number of test frequencies required	Location of measurement frequency inside the operating frequency range
1 MHz or less	1	Center (middle of the band)
1–10 MHz	2	1 near high end, 1 near low end
Greater than 10 MHz	3	1 near high end, 1 near center and 1 near low end

Notes: "near" means as close as possible to or at the centre / low end / high end of the frequency range over which the device operates.

8.2.2 Test summary

Verdict	Pass			
Tested by	D. Guarnone	Test date	April 30, 2021	Sample tested

8.2.3 Observations, settings and special notes

ANSI C63.10, Clause 5.6.2.1:

The number of channels tested can be reduced by measuring the center channel bandwidth first and then applying the following relaxations as appropriate:

- For each operating mode, if the measured channel bandwidth on the middle channel is at least 150% of the minimum permitted bandwidth, then it is not necessary to measure the bandwidth on the high and low channels.
- For multiple-input multiple-output (MIMO) systems, if the measured channel bandwidth on testing the middle channel exceeds the minimum permitted bandwidth by more than 50% on one transmit chain, then it is not necessary to repeat testing on the other chains.
- If the measured channel bandwidth on the middle channel is less than 50% of the maximum permitted bandwidth, then it is not necessary to measure the bandwidth on the high and low channels.

ANSI C63.10, Clause 5.6.2.2:

For devices with multiple operating modes, measurements on the middle channel can be used to determine the worst-case mode(s). The worst-case modes are as follows:

- Band edge requirements—Measurements on the mode with the widest bandwidth can be used to cover the same channel (center frequency) on modes with narrower bandwidth that have the same or lower output power for each modulation family (e.g., OFDM and direct sequence spread spectrum).
- Spurious emissions—Measure the mode with the highest output power and the mode with the highest output power spectral density for each modulation family (e.g., OFDM and direct sequence spread spectrum).
- In-band PSD—Measurements on the mode with the narrowest bandwidth can be used to cover all modes within the same modulation family of an equal or lower output power provided the result is less than 50% of the limit.

8.2.4 Test data

Table 8.2-2: Test channels selection

Start of Frequency range, MHz	End of Frequency range, MHz	Frequency range bandwidth, MHz	Low channel, MHz	Mid channel, MHz	High channel, MHz
2400	2483.5	83.5	2402	2440	2480

8.3 Antenna requirement

8.3.1 References, definitions and limits

FCC §15.203:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

FCC §15.247:

- (b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:
- (4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

RSS-Gen, Clause 6.8:

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report.

8.3.2 Test summary

Verdict	Pass
Tested by	D. Guarnone

Test date

May 3, 2021

Sample tested

4366730002

8.3.3 Observations, settings and special notes

None

8.3.4 Test data

Must the EUT be professionally installed? YES NO

Does the EUT have detachable antenna(s)? YES NO

If detachable, is the antenna connector(s) non-standard? YES NO N/A

Table 8.3-1: Antenna information

Antenna type	Manufacturer	Model number	Maximum gain	Connector type
--	--	--	--	--



8.4 Minimum 6 dB bandwidth for DTS systems

8.4.1 References, definitions and limits

FCC §15.247:

(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

(2) Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

RSS-247, Clause 5.2:

DTSs include systems that employ digital modulation techniques resulting in spectral characteristics similar to direct sequence systems. The following applies to the bands 902-928 MHz and 2400-2483.5 MHz:

a. The minimum 6 dB bandwidth shall be 500 kHz.

RSS-Gen, Clause 6.7:

6 dB bandwidth is defined as the frequency range between two points, one at the lowest frequency below and one at the highest frequency above the carrier frequency, at which the maximum power level of the transmitted emission is attenuated 6 dB below the maximum in-band power level of the modulated signal, where the two points are on the outskirts of the in-band emission.

For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth).

8.4.2 Test summary

Verdict	Pass				
Tested by	D. Guarnone	Test date	May 3, 2021	Sample tested	4366730002

8.4.3 Observations, settings and special notes

The test was performed as per KDB 558074, section 8.2 with reference to ANSI C63.10 subclause 11.8.

Spectrum analyser settings:

Resolution bandwidth	6 dB BW: 100 kHz; 99% OBW: 1–5% of OBW
Video bandwidth	≥3 × RBW
Frequency span	5 MHz
Detector mode	Peak
Trace mode	Max Hold

8.4.4 Test equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
Spectrum Analyzer (2 Hz ÷ 43 GHz)	Rohde & Schwarz	FSW43	101767	01/2021	01/2022
Semi-anechoic chamber	Nemko S.p.a.	10m semi-anechoic chamber	530	2019-09	2021-09
Antenna 1 - 18 GHz	Schwarzbeck Mess-Elektronik	STLP9148	STLP 9148-152	2018-09	2021-09

8.4.5 Test data

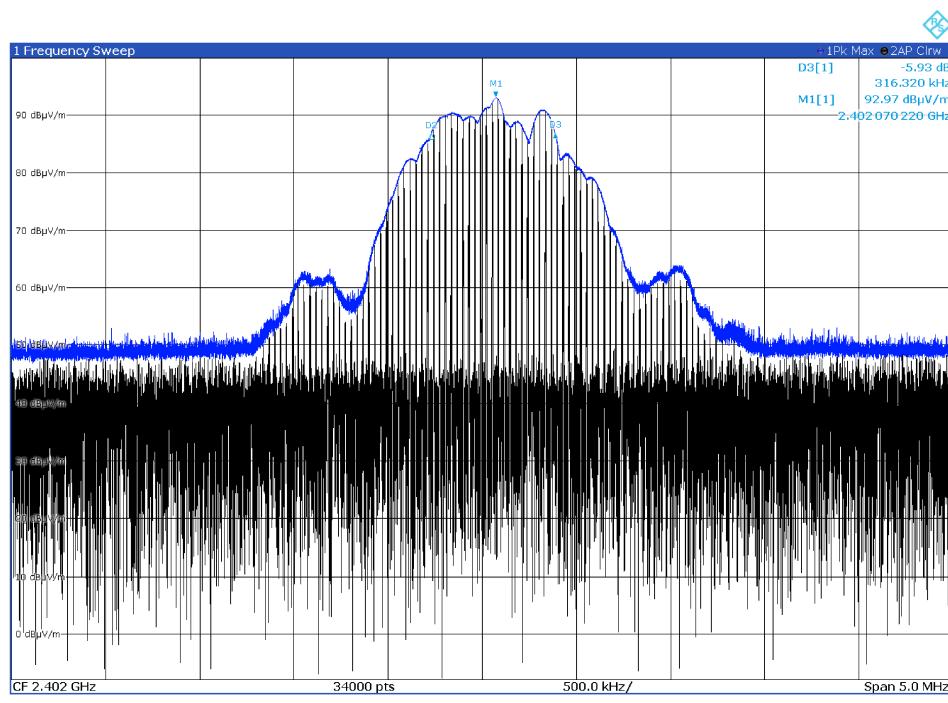
Table 8.4-1: 99% occupied bandwidth results

Modulation	Frequency, MHz	99% occupied bandwidth, kHz
BLE (GFSK)	2402	1055
	2440	1069
	2480	1077

Notes: There is no 99% occupied bandwidth limit in the standard's requirements, the measurement results provided for information purposes only.

Table 8.4-2: 6 dB bandwidth results

Modulation	Frequency, MHz	6 dB bandwidth, MHz	Minimum limit, MHz	Margin, MHz
BLE (GFSK)	2402	0.657	0.500	0.157
	2440	0.654	0.500	0.154
	2480	0.686	0.500	0.186



16:31:44 03.05.2021

Page 1/2

Figure 8.4-1: 6 dB bandwidth on low channel=656.76 KHz

2 Marker Table						
Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1	1		2.402 070 22 GHz	92.97 dBμV/m		
D2	M1	1	-340.44 kHz	-5.99 dB		
D3	M1	1	316.32 kHz	-5.93 dB		

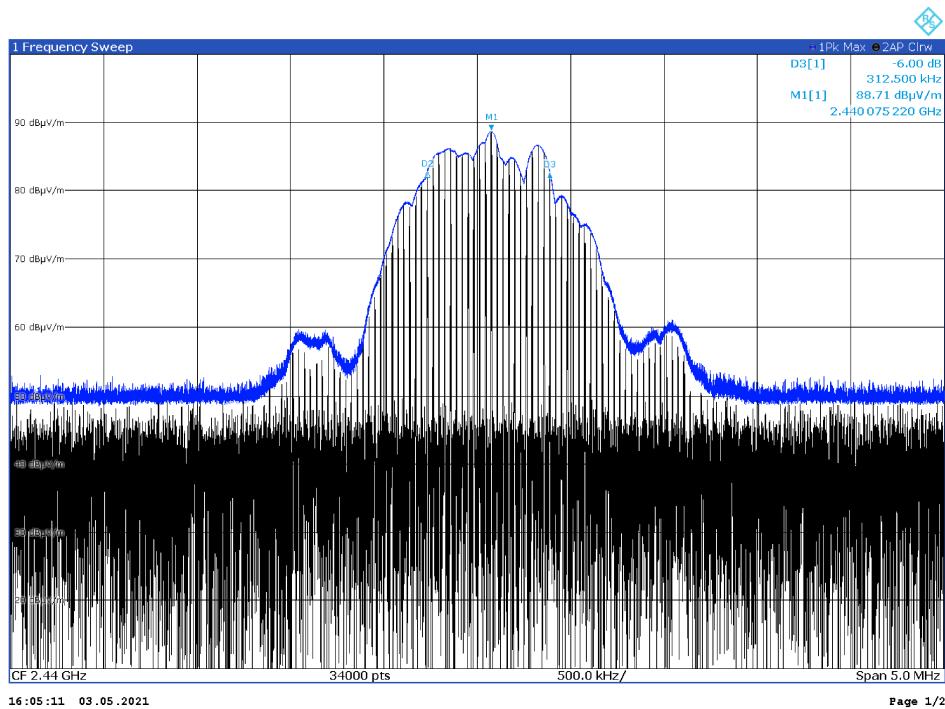


Figure 8.4-2: 6 dB bandwidth on mid channel=654.12 kHz

2 Marker Table						
Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	2.440 075 22 GHz	88.71 dBμV/m		
D2	M1	1	-341.62 kHz	-5.94 dB		
D3	M1	1	312.5 kHz	-6.00 dB		

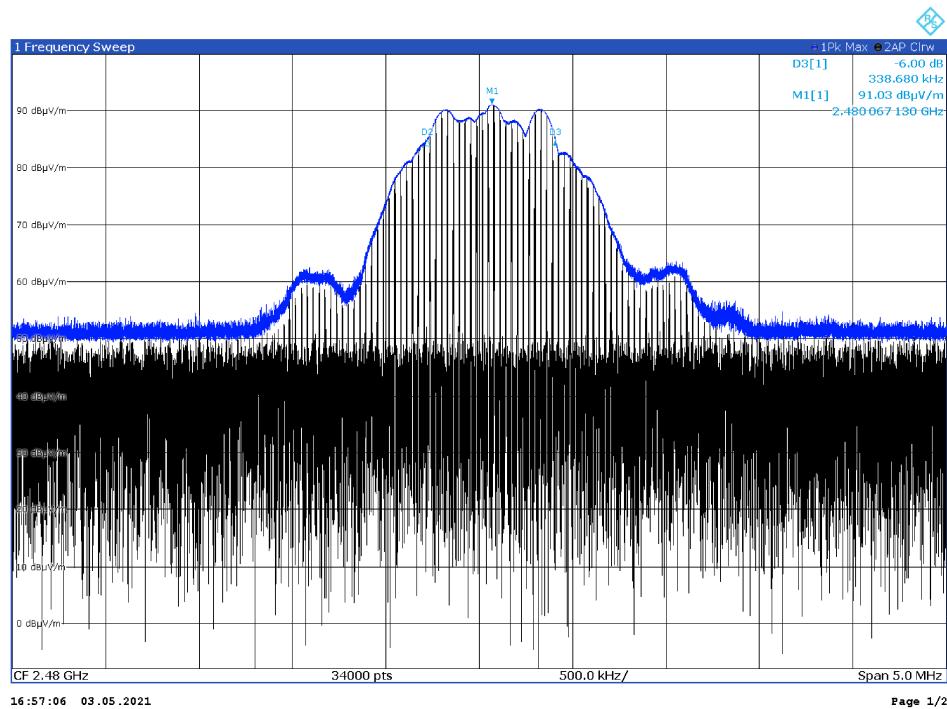


Figure 8.4-3: 6 dB bandwidth on high channel=686.03 kHz

2 Marker Table						
Type	Ref	Trc	X-Value	V-Value	Function	Function Result
M1	1		2.480 067 13 GHz	91.03 dBμV/m		
D2	M1	1	-347.35 kHz	-6.09 dB		
D3	M1	1	338.68 kHz	-6.00 dB		

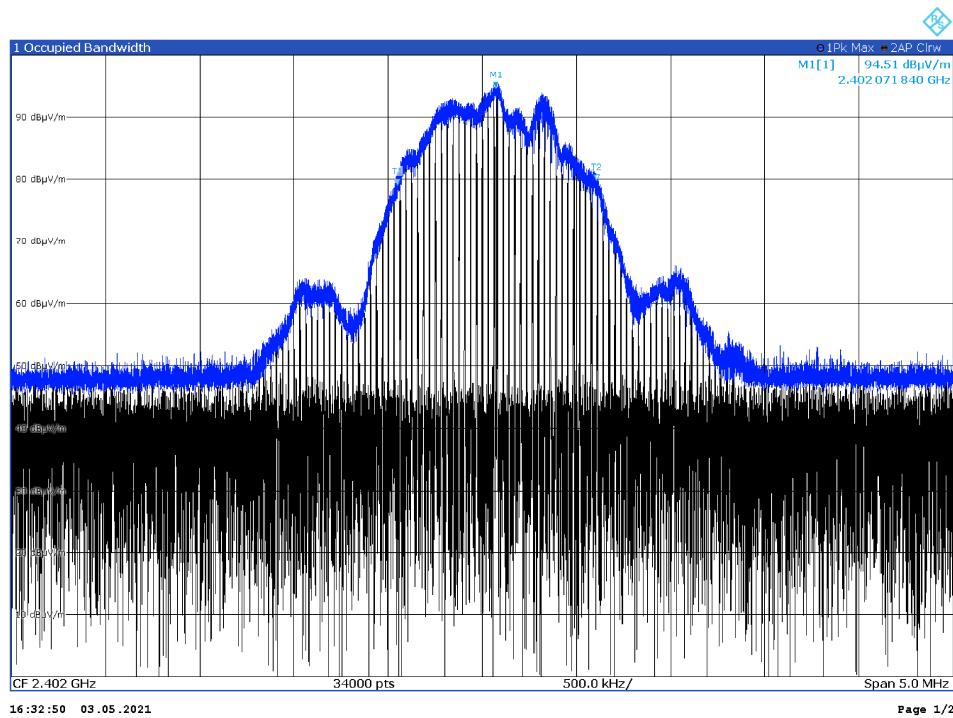


Figure 8.4-4: 99% occupied bandwidth on low channel= 1.055 MHz

2 Marker Table						
Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1	1		2.402 071 84 GHz	94.51 dBμV/m	Count	2.402 072 338 5 GHz
					Occ Bw	1.054 762 59 MHz
T1	1		2.401 550 046 GHz	78.94 dB μ V/m	Occ Bw Centroid	2.402 077 427 GHz
T2	1		2.402 604 808 GHz	79.60 dB μ V/m	Occ Bw Freq Offset	77.427 159 248 kHz

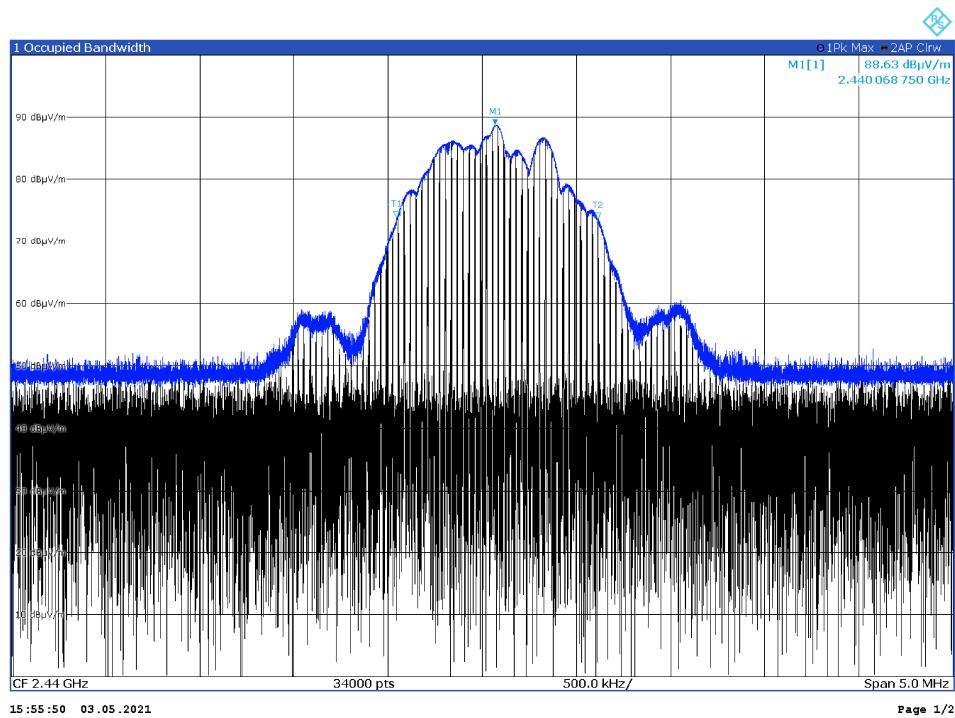


Figure 8.4-5: 99% occupied bandwidth on mid channel=1.069 MHz

2 Marker Table						
Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1	1		2.440 068 75 GHz	88.63 dBµV/m	Occ Bw	1.069 255 655 MHz
T1	1		2.439 545 081 GHz	73.77 dBµV/m	Occ Bw Centroid	2.440 079 709 GHz
T2	1		2.440 614 337 GHz	73.54 dBµV/m	Occ Bw Freq Offset	79.708 837 286 kHz

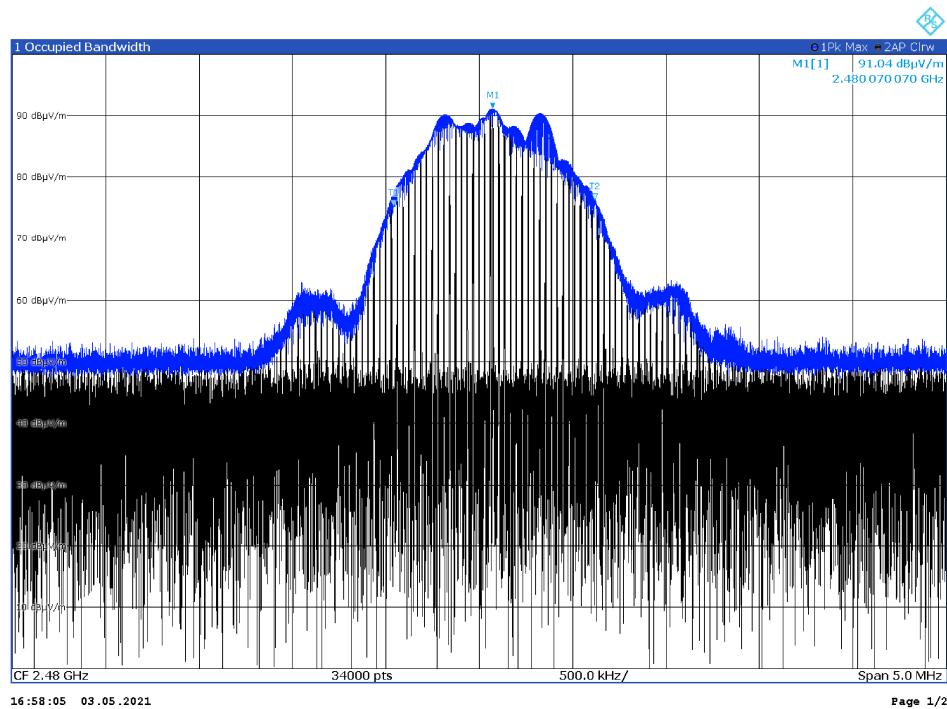


Figure 8.4-6: 99% occupied bandwidth on high channel=1.077 MHz

2 Marker Table						
Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1	1		2.480 070 07 GHz	91.04 dBμV/m	Count Occ Bw	2.480 069 072 7 GHz 1.076 638 165 MHz
T1	1		2.479 539 637 GHz	75.14 dBμV/m	Occ Bw Centroid	2.480 077 956 GHz
T2	1		2.480 616 275 GHz	76.17 dBμV/m	Occ Bw Freq Offset	77.955 727 629 kHz

8.5 Transmitter output power and e.i.r.p. requirements for DTS in 2.4 GHz

8.5.1 References, definitions and limits

FCC §15.247:

- (b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:
 - (3) For systems using digital modulation in the 2400–2483.5 MHz band: 1 W (30 dBm). As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.
 - (4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.
 - (c) Operation with directional antenna gains greater than 6 dBi.
 - (1) Fixed point-to-point operation:
 - (i) Systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.
 - (ii) Fixed, point-to-point operation, as used in paragraphs (c)(1)(i) and (c)(1)(ii) of this section, excludes the use of point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum or digitally modulated intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.
 - (2) In addition to the provisions in paragraphs (b)(1), (b)(3), (b)(4) and (c)(1)(i) of this section, transmitters operating in the 2400–2483.5 MHz band that emit multiple directional beams, simultaneously or sequentially, for the purpose of directing signals to individual receivers or to groups of receivers provided the emissions comply with the following:
 - (i) Different information must be transmitted to each receiver.
 - (ii) If the transmitter employs an antenna system that emits multiple directional beams but does not do emit multiple directional beams simultaneously, the total output power conducted to the array or arrays that comprise the device, i.e., the sum of the power supplied to all antennas, antenna elements, staves, etc. and summed across all carriers or frequency channels, shall not exceed the limit specified in paragraph (b)(1) or (b)(3) of this section, as applicable. However, the total conducted output power shall be reduced by 1 dB below the specified limits for each 3 dB that the directional gain of the antenna/antenna array exceeds 6 dBi. The directional antenna gain shall be computed as follows:
 - (A) The directional gain shall be calculated as the sum of $10 \log$ (number of array elements or staves) plus the directional gain of the element or stave having the highest gain.
 - (B) A lower value for the directional gain than that calculated in paragraph (c)(2)(ii)(A) of this section will be accepted if sufficient evidence is presented, e.g., due to shading of the array or coherence loss in the beamforming.
 - (iii) If a transmitter employs an antenna that operates simultaneously on multiple directional beams using the same or different frequency channels, the power supplied to each emission beam is subject to the power limit specified in paragraph (c)(2)(ii) of this section. If transmitted beams overlap, the power shall be reduced to ensure that their aggregate power does not exceed the limit specified in paragraph (c)(2)(ii) of this section. In addition, the aggregate power transmitted simultaneously on all beams shall not exceed the limit specified in paragraph (c)(2)(ii) of this section by more than 8 dB.
 - (iv) Transmitters that emit a single directional beam shall operate under the provisions of paragraph (c)(1) of this section.



8.5.2 Test summary

Verdict	Pass				
Tested by	D. Guarnone	Test date	May 3, 2021	Sample tested	4366730002

8.5.3 Test equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
Spectrum Analyzer (2 Hz ÷ 43 GHz)	Rohde & Schwarz	FSW43	101767	01/2021	01/2022
Semi-anechoic chamber	Nemko S.p.a.	10m semi-anechoic chamber	530	2019-09	2021-09
Antenna 1 - 18 GHz	Schwarzbeck Mess-Elektronik	STLP9148	STLP 9148-152	2018-09	2021-09

8.5.4 Observations, settings and special notes

The test was performed as per KDB 558074, section 8.3 with reference to ANSI C63.10 subclause 11.9.1 (peak power) using method $RBW \geq DTS$ bandwidth (Maximum peak conducted output power)

Spectrum analyser settings:

Resolution bandwidth	3 MHz
Video bandwidth	$\geq 3 \times RBW$
Frequency span	20 MHz
Detector mode	Peak
Trace mode	Max hold

8.5.5 Test data

Table 8.5-1: Output power and EIRP results (antenna port measurement)

Output power was calculated as follows:

0 dBm eirp are 95.2 dBuV/m at 3m:

Vertical polarization

Modulation	Frequency, MHz	dBm		Margin, dB	Antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB	E Field dBuV/m
		Measured	Limit						
BLE	2402	-14.56	36	-50.56	1.1	-13.46	30	-43.46	81.74
	2440	-14.68	36	-50.68	1.1	-13.58	30	-43.58	81.62
	2480	-11.93	36	-47.93	1.1	-10.83	30	-40.83	84.37

Horizontal polarization

Modulation	Frequency, MHz	dBm		Margin, dB	Antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB	E Field dBuV/m
		Measured	Limit						
BLE	2402	3.05	36	-32.95	1.1	4.15	30	-25.85	99.35
	2440	1.26	36	-34.74	1.1	2.36	30	-27.64	97.56
	2480	0.37	36	-35.63	1.1	1.47	30	-28.53	96.67

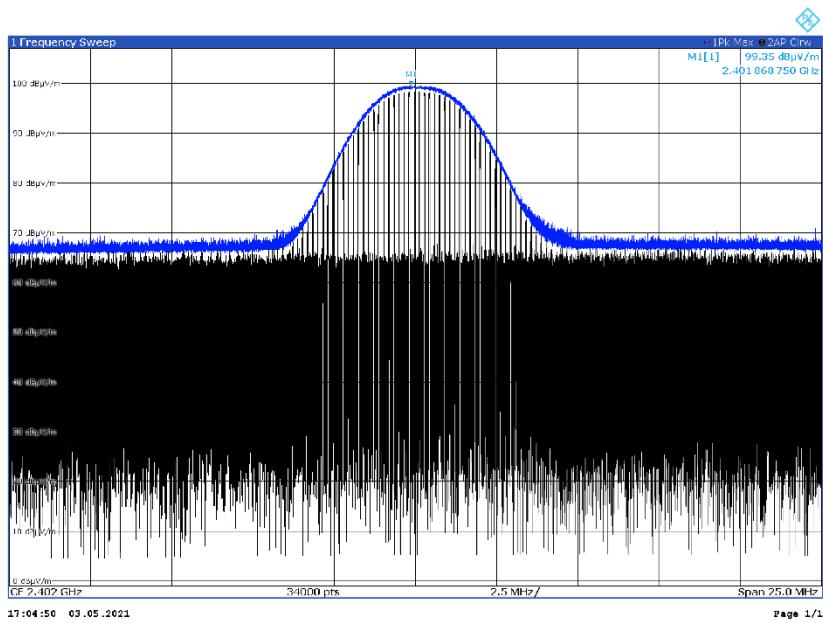


Figure 8.5-1: E FIELD on low channel, horizontal polarization

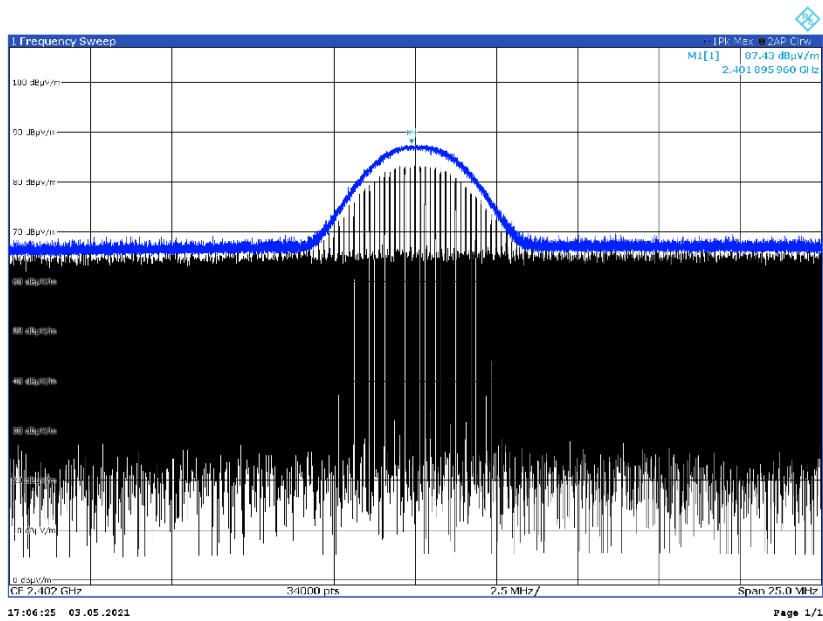


Figure 8.5 2: E FIELD on low channel, vertical polarization

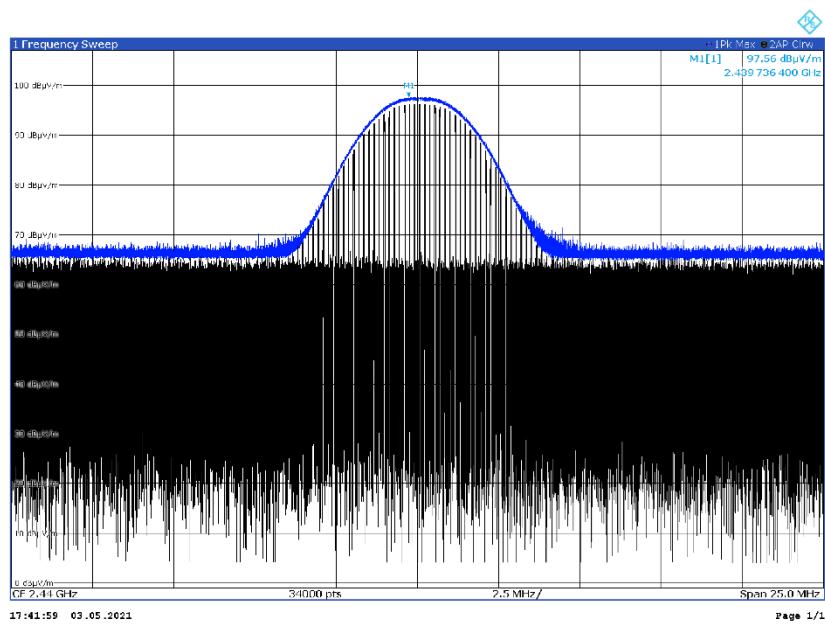


Figure 8.5-3: E FIELD on middle channel, horizontal polarization

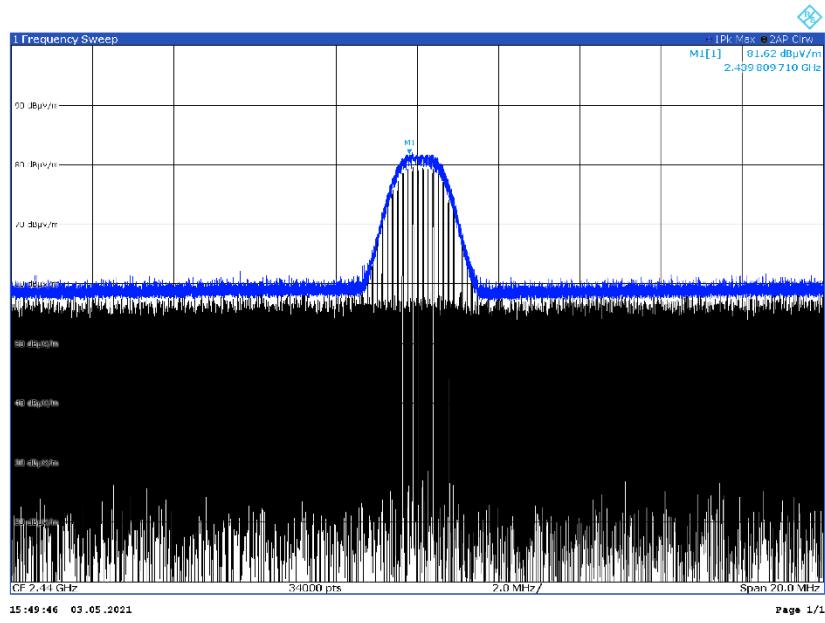


Figure 8.5-4: E FIELD on middle channel, vertical polarization

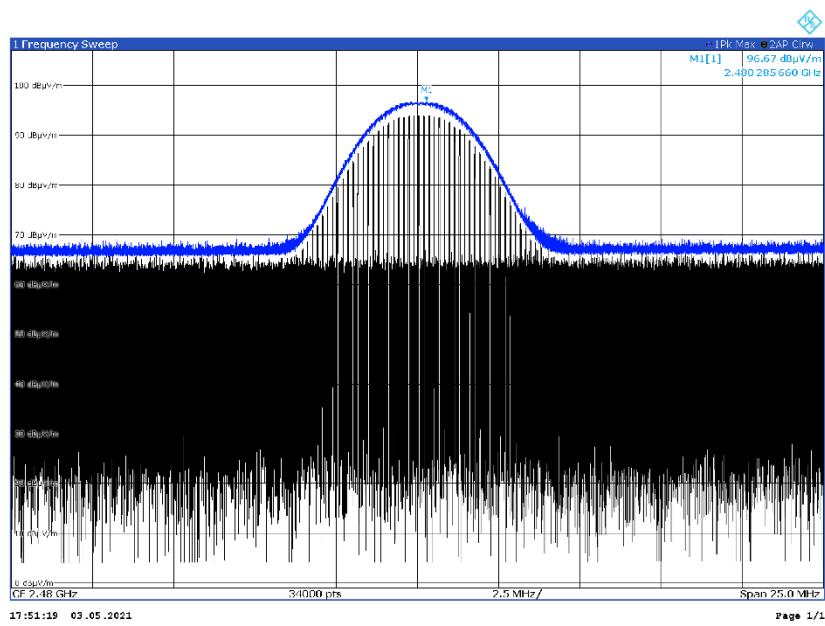


Figure 8.5-5: E FIELD on high channel, horizontal polarization

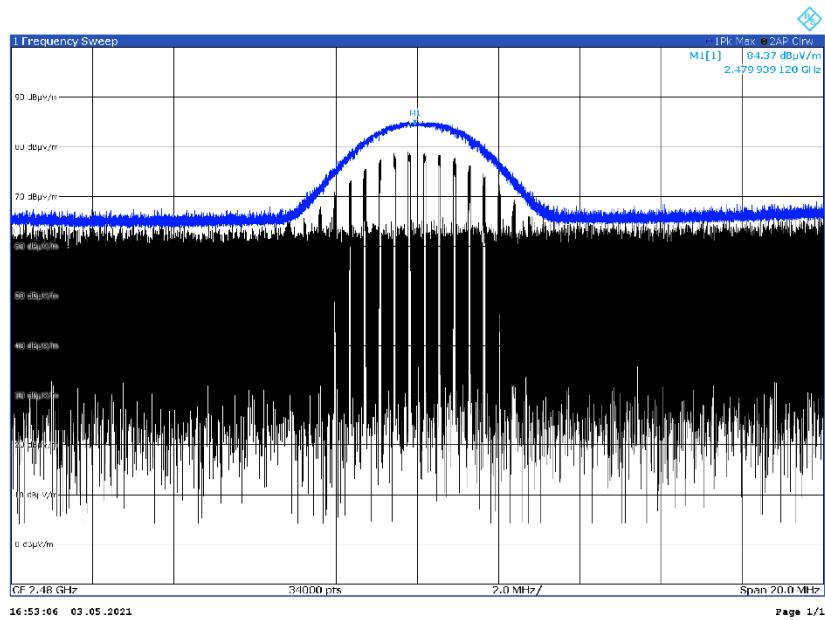


Figure 8.5-6: E FIELD on high channel, vertical polarization

8.6 Spurious (out-of-band) unwanted emissions

8.6.1 References, definitions and limits

FCC §15.247:

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Table 8.6-1: FCC §15.209 – Radiated emission limits

Field strength of emissions			
Frequency, MHz	µV/m	dBµV/m	Measurement distance, m
0.009–0.490	2400/F	67.6 – 20 × log ₁₀ (F)	300
0.490–1.705	24000/F	87.6 – 20 × log ₁₀ (F)	30
1.705–30.0	30	29.5	30
30–88	100	40.0	3
88–216	150	43.5	3
216–960	200	46.0	3
above 960	500	54.0	3

Notes: In the emission table above, the tighter limit applies at the band edges.

For frequencies above 1 GHz the limit on peak RF emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test.

References, definitions and limits, continued

Table 8.6-2: FCC restricted frequency bands

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2690–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	Above 38.6
13.36–13.41			

8.6.2 Test summary

Verdict	Pass		
Tested by	D. Guarnone	Test date	August 31, 2021
Sample tested	4318570002 for band-edge test in non-restricted frequency bands and 4318570001 for the others		

8.6.3 Observations, settings and special notes

- As part of the current assessment, the test range of 9 kHz to 10th harmonic has been fully considered and compared to the actual frequencies utilized within the EUT. Since the EUT contains a transmitter in the GHz range, the EUT has been deemed compliant without formal testing in the 9 kHz to 30 MHz test range, therefore formal test results (tabular data and/or plots) are not provided within this test report.
- Radiated measurements were performed at a distance of 3 m.
- DTS emissions in non-restricted frequency bands test was performed as per KDB 558074, section 8.5 with reference to ANSI C63.10 subclause 11.11.
- Since fundamental power was tested using the maximum peak conducted output power procedure to demonstrate compliance, the spurious emissions limit is -20 dBc/100 kHz.
- DTS emissions in restricted frequency bands test was performed as per KDB 558074, section 8.6 with reference to ANSI C63.10 subclause 11.12.
- DTS band-edge emission measurements test was performed as per KDB 558074, section 8.7 with reference to ANSI C63.10 subclause 11.13.

Spectrum analyser settings for radiated measurements within restricted bands below 1 GHz:

Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Detector mode:	Peak
Trace mode:	Max Hold

Spectrum analyser settings for peak radiated measurements within restricted bands above 1 GHz:

Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Detector mode:	Peak
Trace mode:	Max Hold

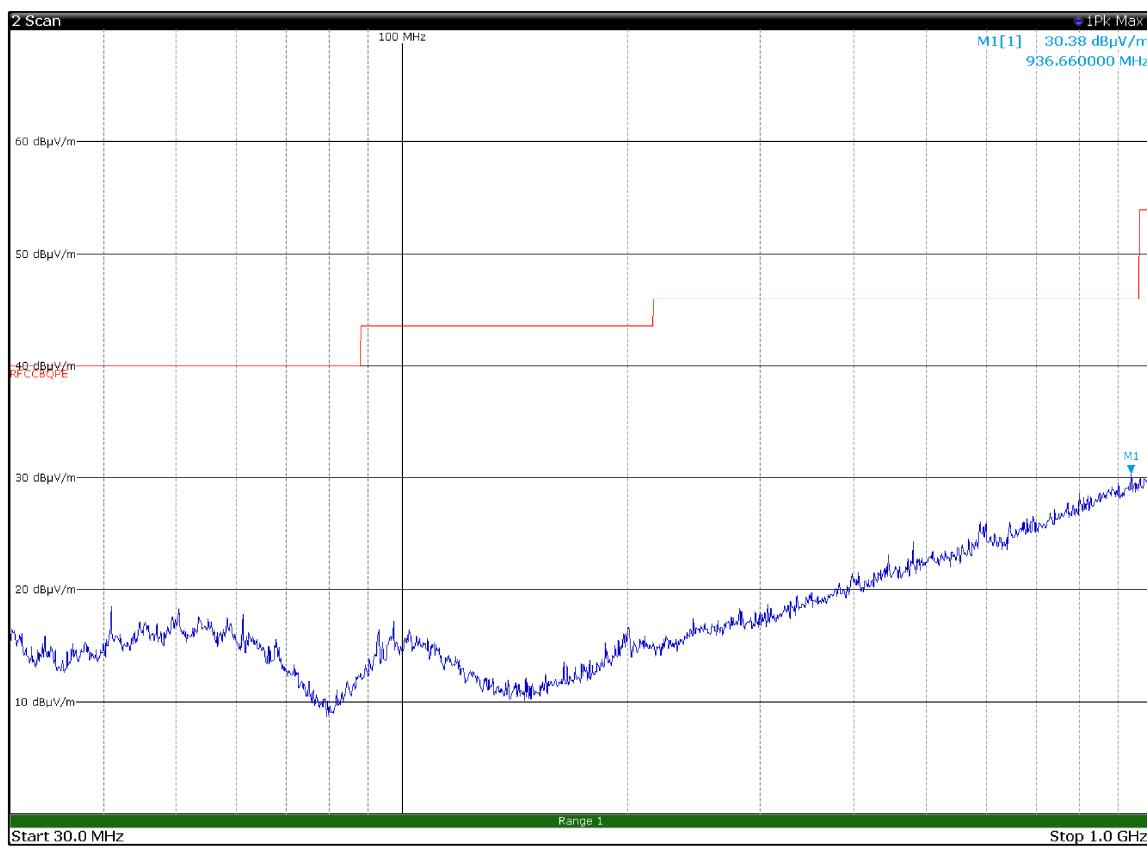
Spectrum analyser settings for average radiated measurements within restricted bands above 1 GHz:

Resolution bandwidth:	1 MHz
Video bandwidth:	10 Hz
Detector mode:	Peak
Trace mode:	Max Hold

8.6.4 Test equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
EMI receiver (20 Hz ÷ 8 GHz)	Rohde & Schwarz	ESU8	100202	08/2021	08/2022
EMI receiver (2 Hz ÷ 44 GHz)	Rohde & Schwarz	ESW44	101620	08/2021	08/2022
Spectrum Analyzer (2 Hz ÷ 43 GHz)	Rohde & Schwarz	FSW43	101767	01/2021	01/2022
Trilog Antenna (30 MHz ÷ 7 GHz)	Schwarzbeck	VULB 9162	9162-025	07/2021	07/2024
Bilog antenna (1 ÷ 18 GHz)	Schwarzbeck	STLP 9148	9148-123	07/2021	07/2024
Horn Antenna (4 ÷ 40 GHz)	RFSpin	DRH40	061106A40	04/2020	04/2023
Preamplifier (1 ÷ 18 GHz)	Schwarzbeck	BBV 9718C	00121	01/2021	01/2022
Preamplifier (18 ÷ 40 GHz)	Sage	STB-1834034030-KFKF-L1	18490-01	03/2021	03/2022
Controller	Maturo	FCU3.0	10041	NCR	NCR
Tilt antenna mast	Maturo	TAM4.0-E	10042	NCR	NCR
Turntable	Maturo	TT4.0-5T	2.527	NCR	NCR
Semi-anechoic chamber	Nemko	10m semi-anechoic chamber	530	09/2019	09/2021
Shielded room	Siemens	10m control room	1947	NCR	NCR

8.6.5 Test data



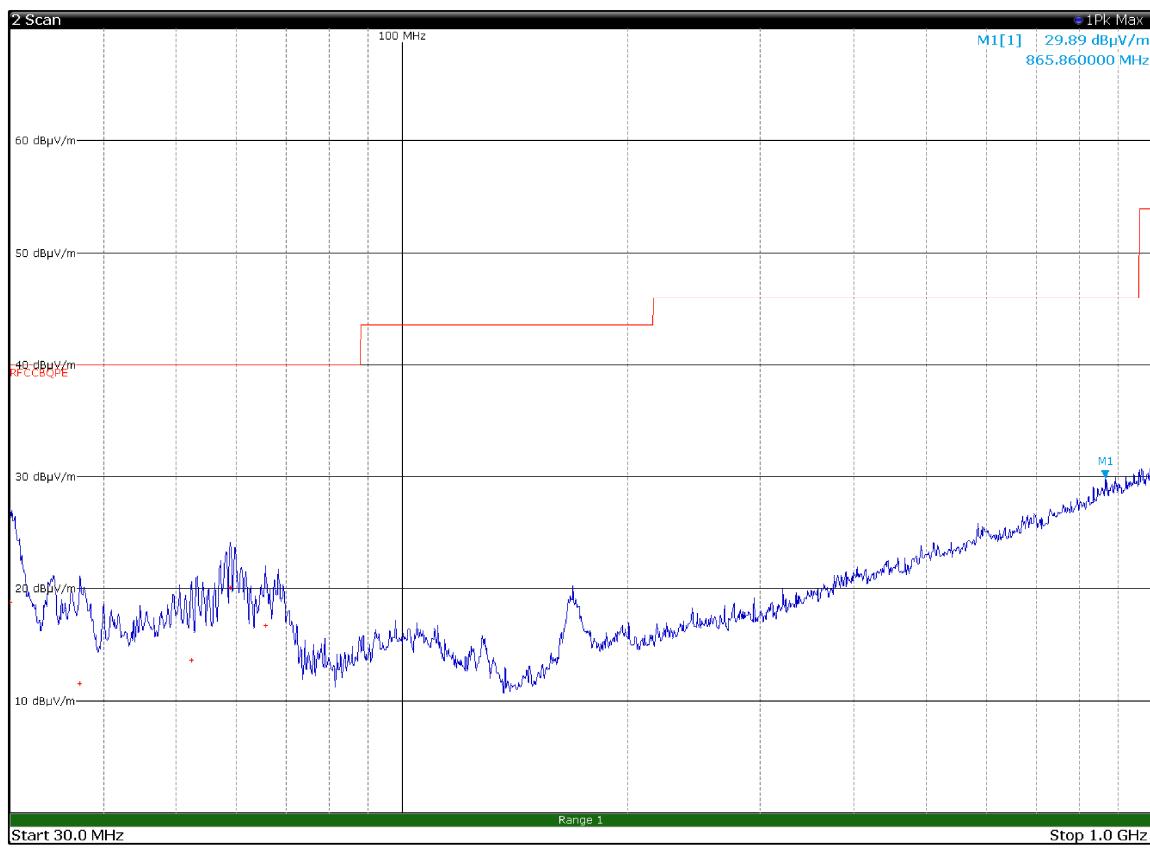
16:56:19 04.05.2021

Page 1/1

Figure 8.6-1: Radiated spurious emissions on low channel with antenna in horizontal polarization

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector
--	--	--	--	--

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.



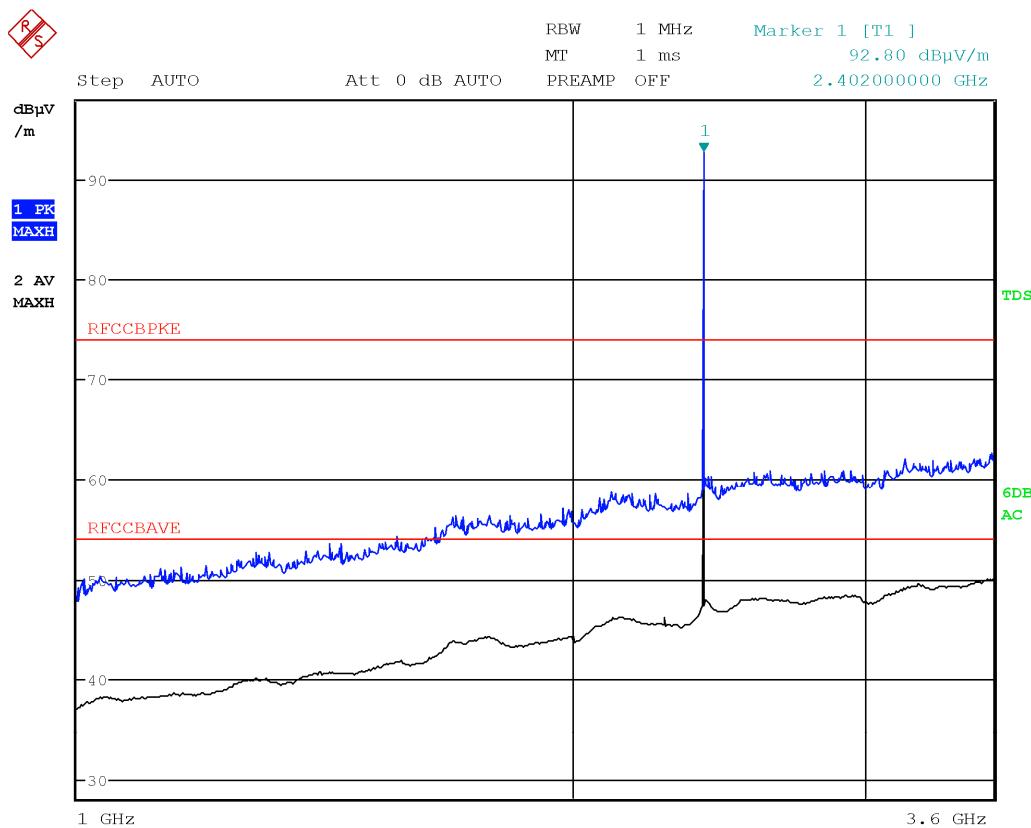
16:52:21 04.05.2021

Page 1/1

Figure 8.6-2: Radiated spurious emissions on low channel with antenna in vertical polarization

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector
30.0000	18.8	40.0	-21.2	QP
37.1700	11.5	40.0	-28.5	QP
52.3500	13.7	40.0	-26.3	QP
59.0100	20.2	40.0	-19.8	QP
65.7600	16.7	40.0	-23.3	QP

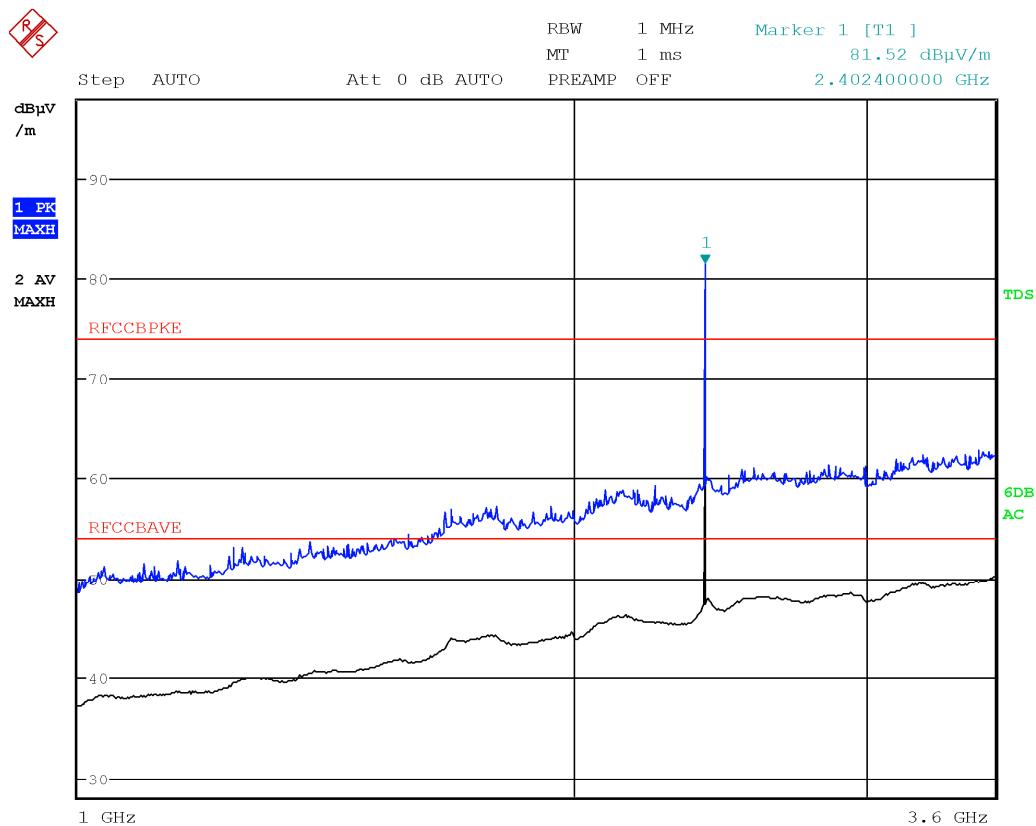
Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.



Date: 5.MAY.2021 19:14:30

Limit exceeded by the carrier

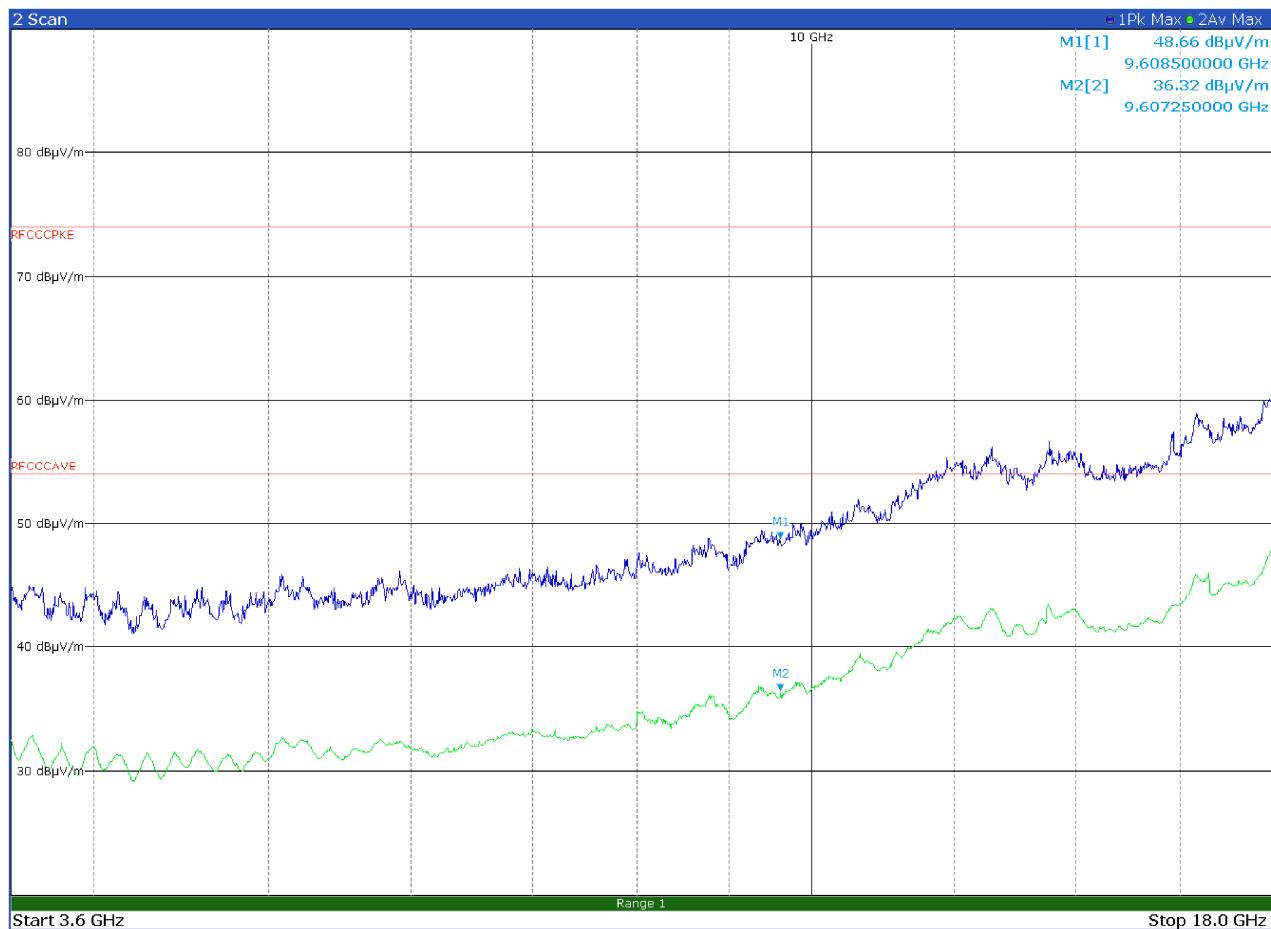
Figure 8.6-3: Radiated spurious emissions on low channel with antenna in horizontal polarization



Date: 5.MAY.2021 19:11:12

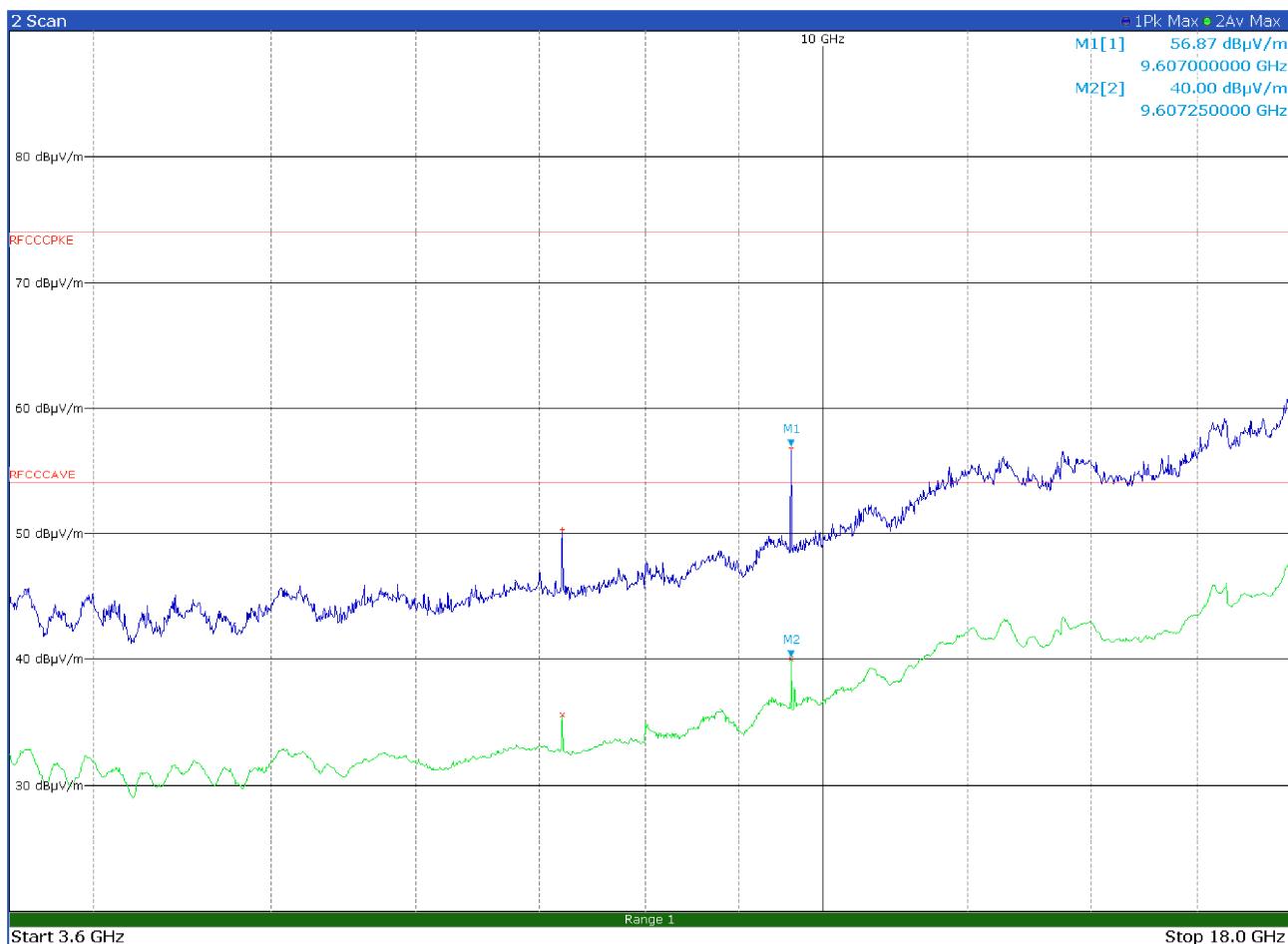
Limit exceeded by the carrier

Figure 8.6-4: Radiated spurious emissions on low channel with antenna in vertical polarization



Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector
--	--	--	--	--

Figure 8.6-5: Radiated spurious emissions on low channel with antenna in horizontal polarization



Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector
--	--	--	--	--

Figure 8.6-6: Radiated spurious emissions on low channel with antenna in vertical polarization

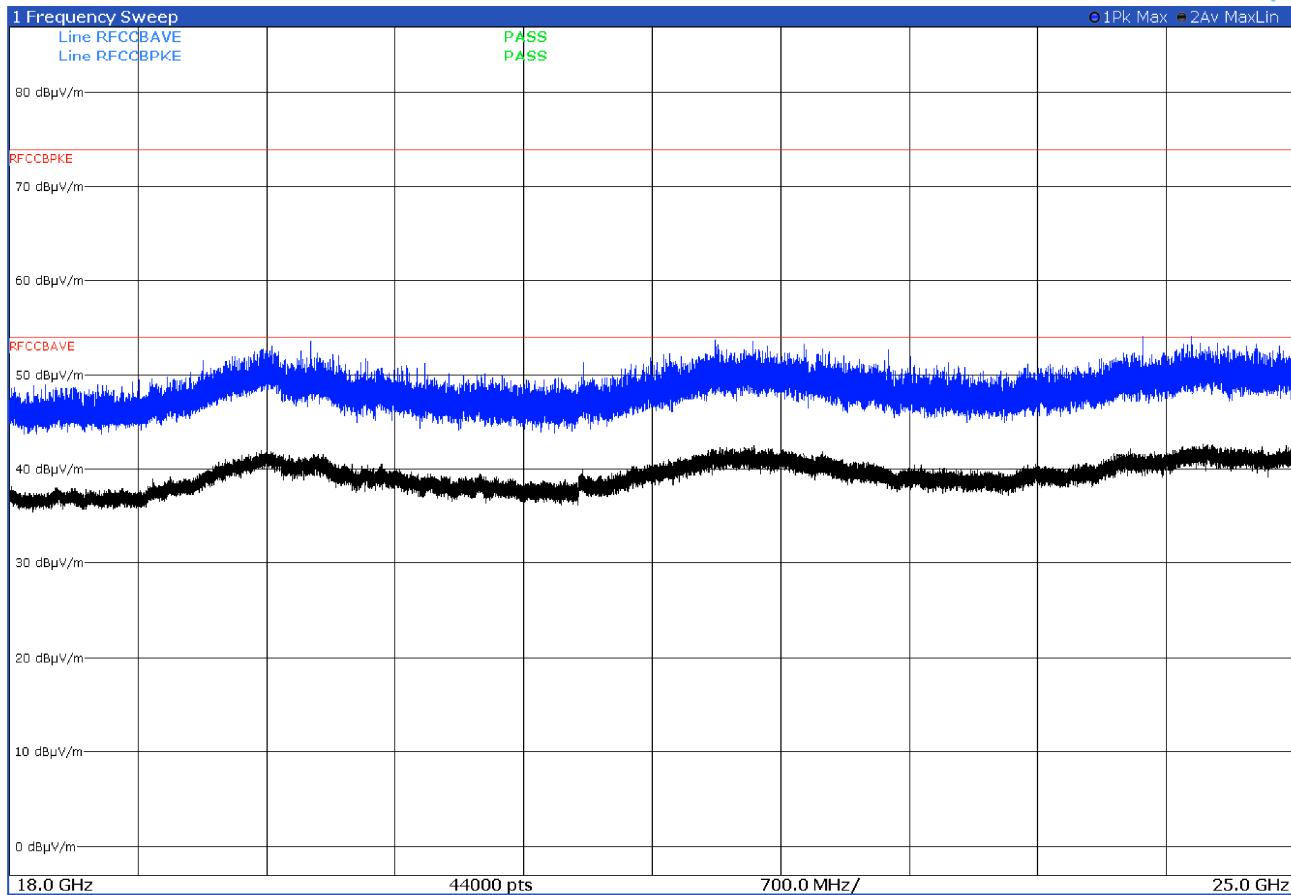


Figure 8.6-7: Radiated spurious emissions on low channel with antenna in horizontal polarization –

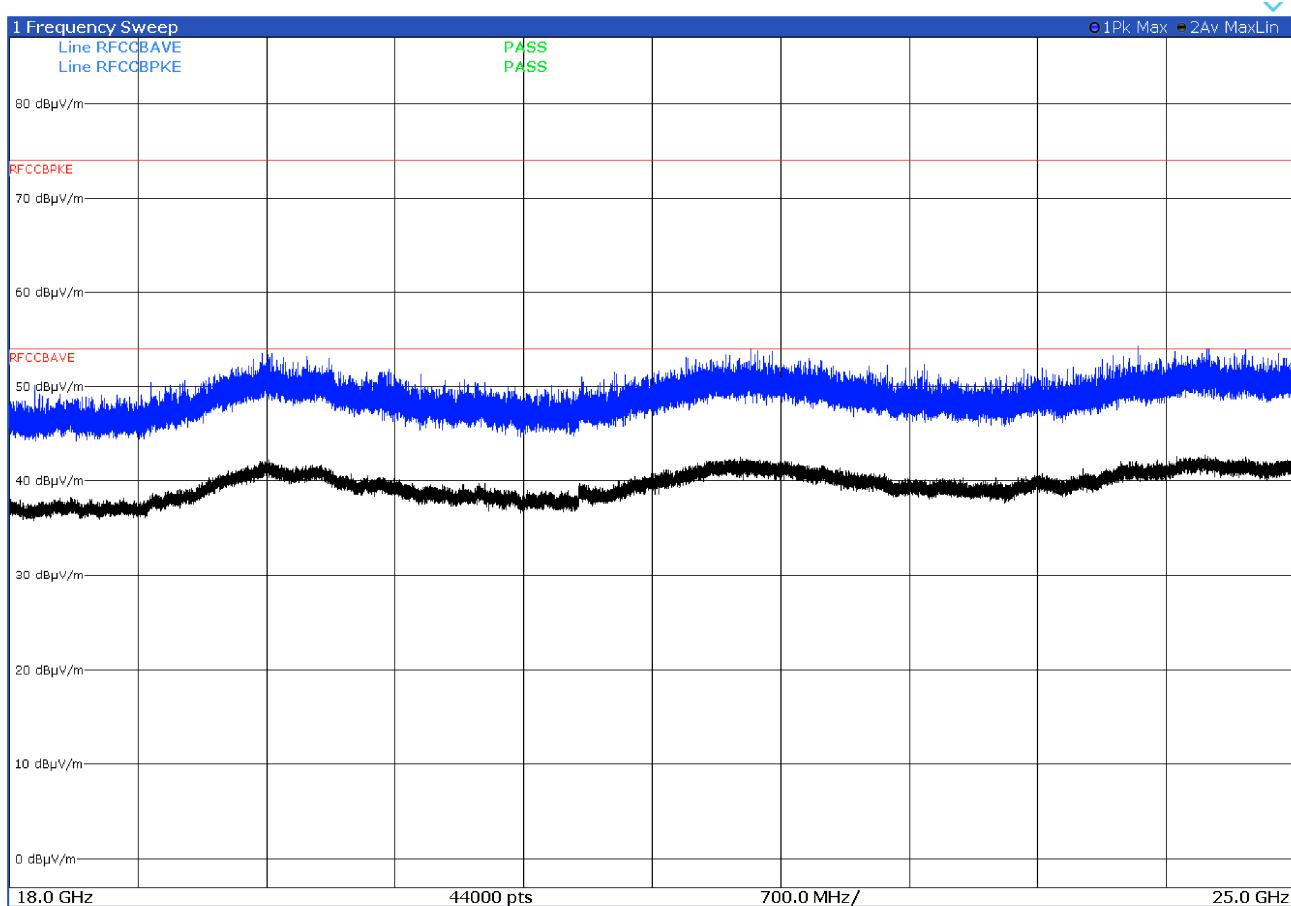
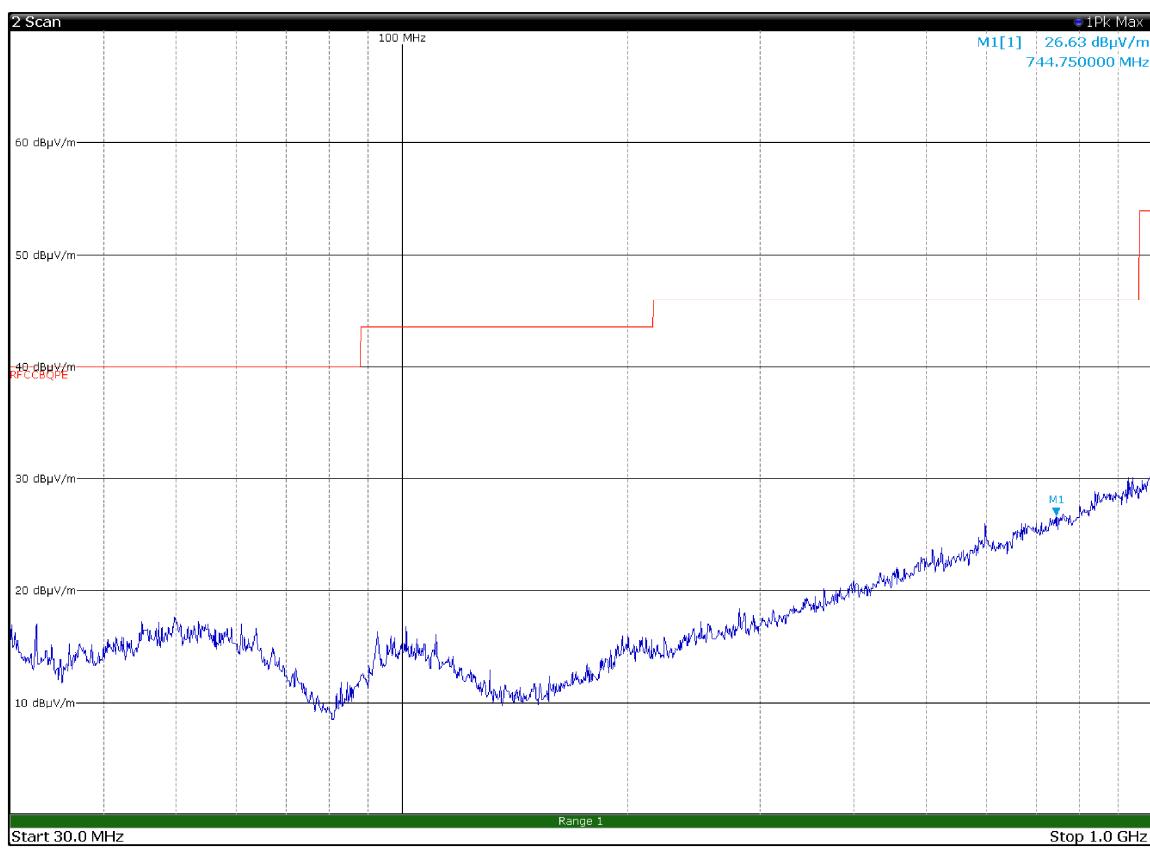


Figure 8.6-8: Radiated spurious emissions on low channel with antenna in vertical polarization –



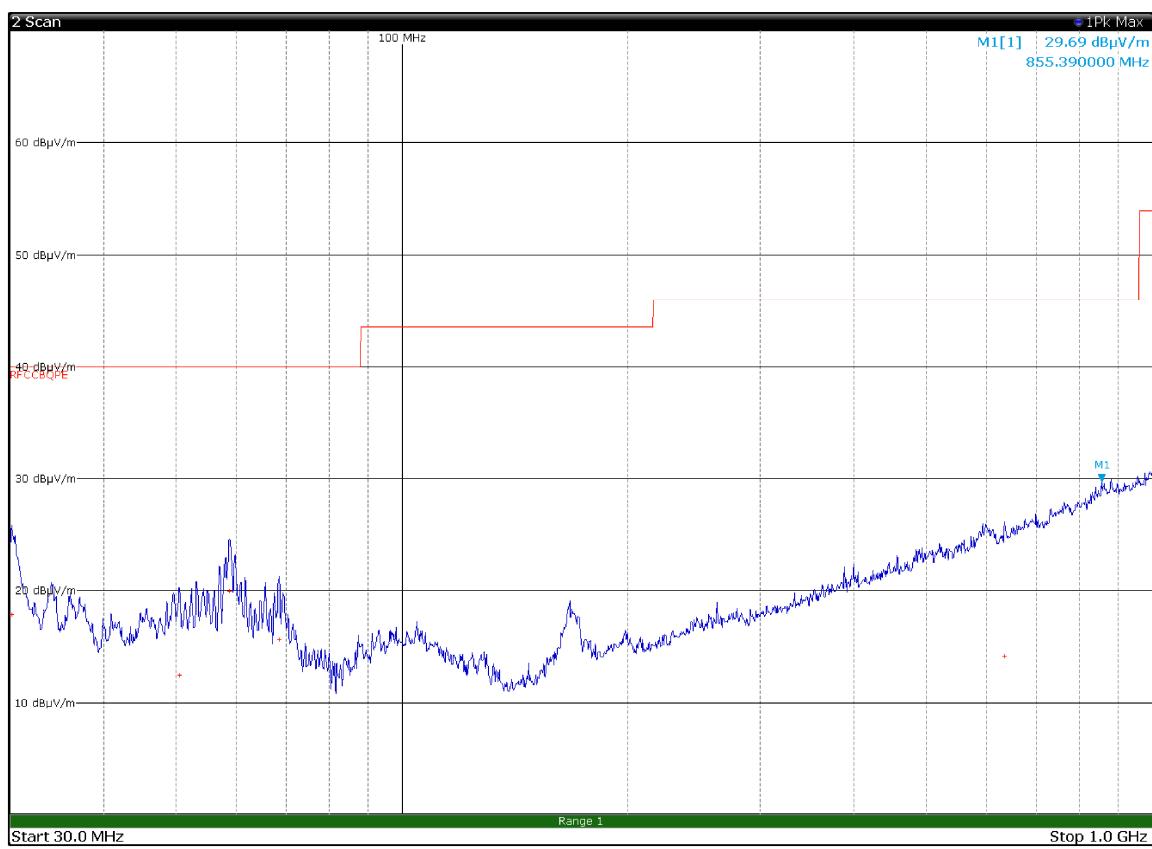
16:59:00 04.05.2021

Page 1/1

Figure 8.6-9: Radiated spurious emissions on mid channel with antenna in horizontal polarization

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector
--	--	--	--	--

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.



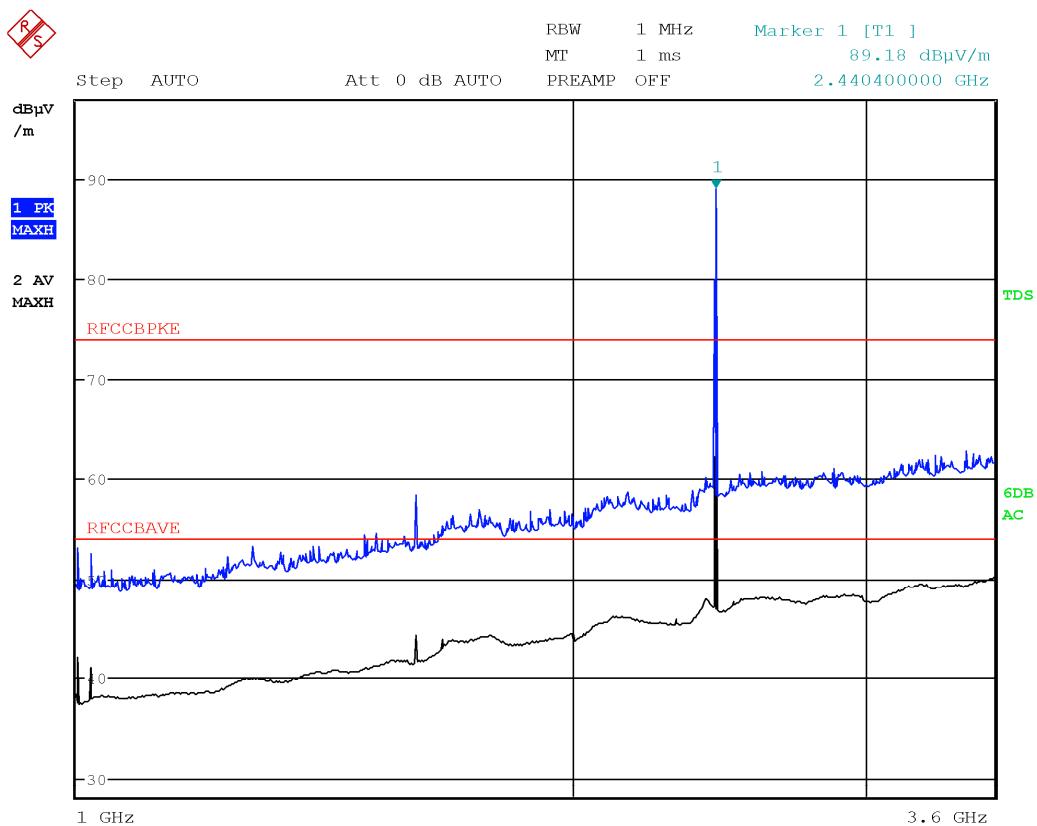
17:01:08 04.05.2021

Page 1/1

Figure 8.6-10: Radiated spurious emissions on mid channel with antenna in vertical polarization

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector
30.0000	18.8	40.0	-21.2	QP
37.1700	11.5	40.0	-28.5	QP
52.3500	13.7	40.0	-26.3	QP
59.0100	20.0	40.0	-20.0	QP
65.7600	16.7	40.0	-23.3	QP

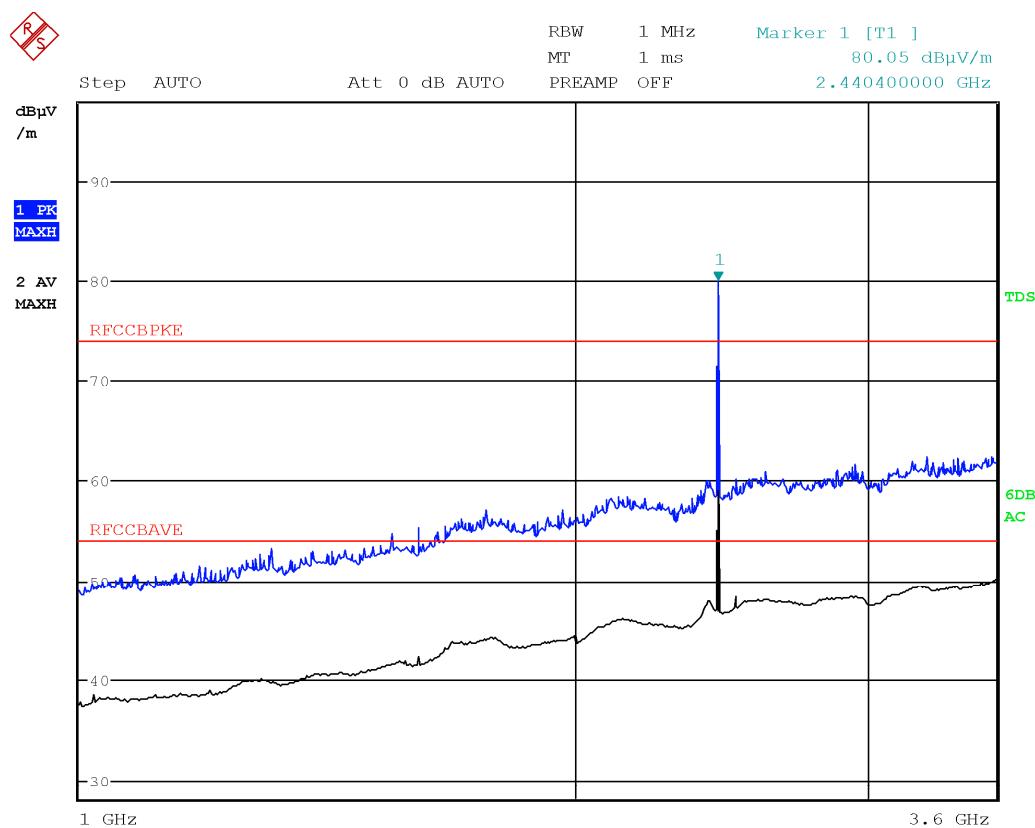
Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.



Date: 5.MAY.2021 18:03:32

Limit exceeded by the carrier

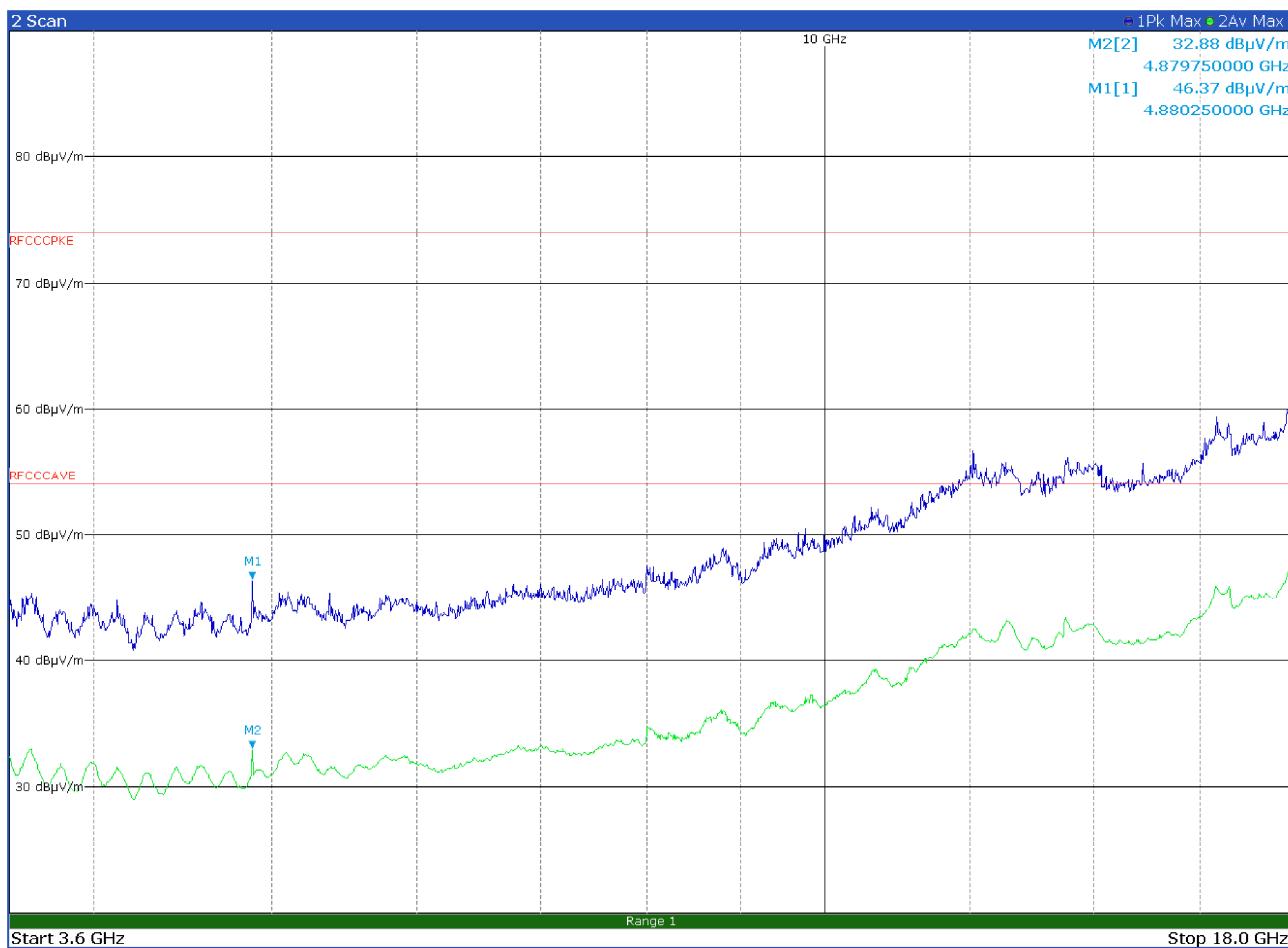
Figure 8.6-11: Radiated spurious emissions on mid channel with antenna in horizontal polarization



Date: 5.MAY.2021 18:04:41

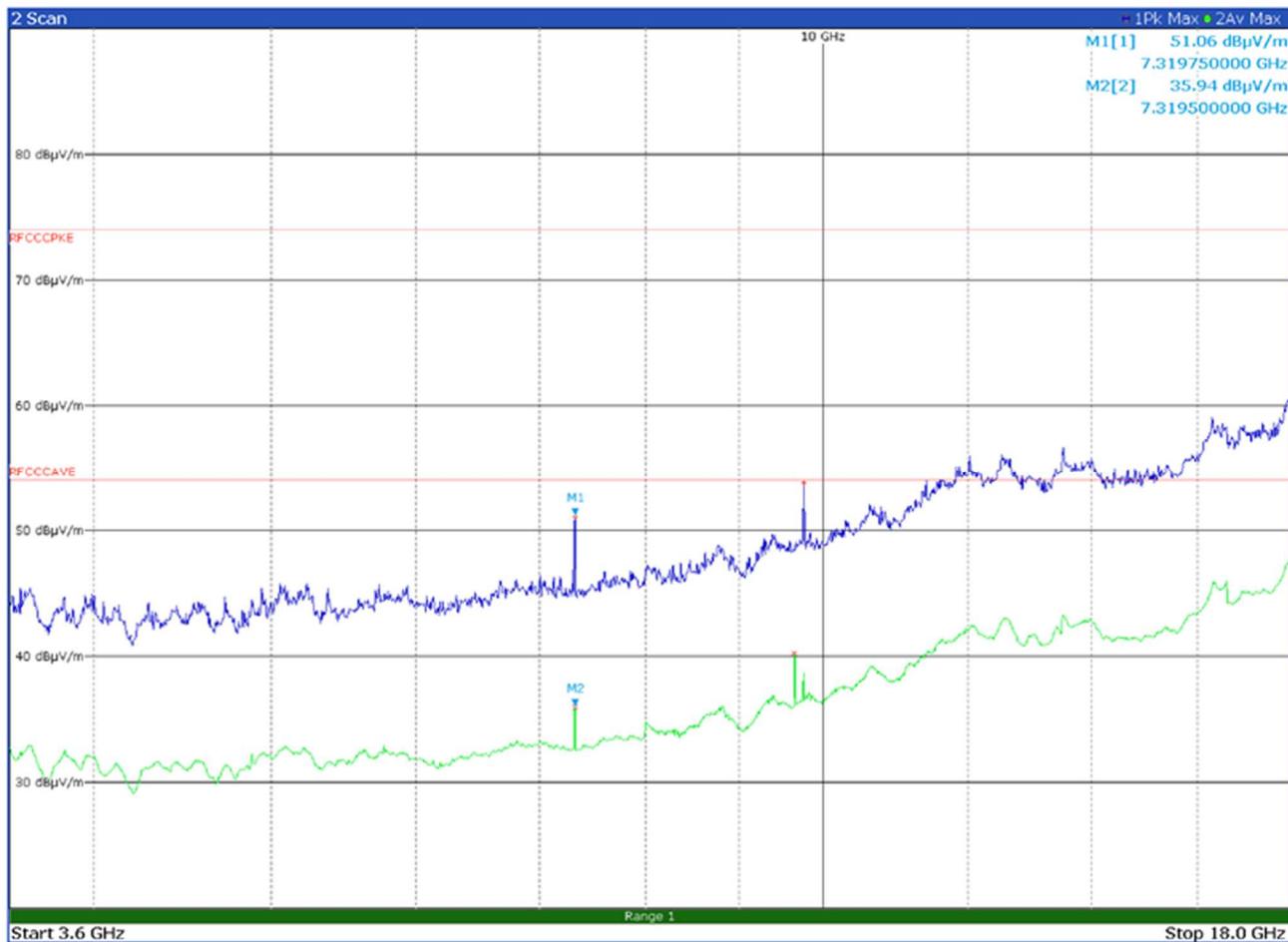
Limit exceeded by the carrier

Figure 8.6-12: Radiated spurious emissions on mid channel with antenna in vertical polarization



Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector
--	--	--	--	--

Figure 8.6-13: Radiated spurious emissions on mid channel with antenna in vertical polarization



Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector
--	--	--	--	--

Figure 8.6-14: Radiated spurious emissions on mid channel with antenna in horizontal polarization

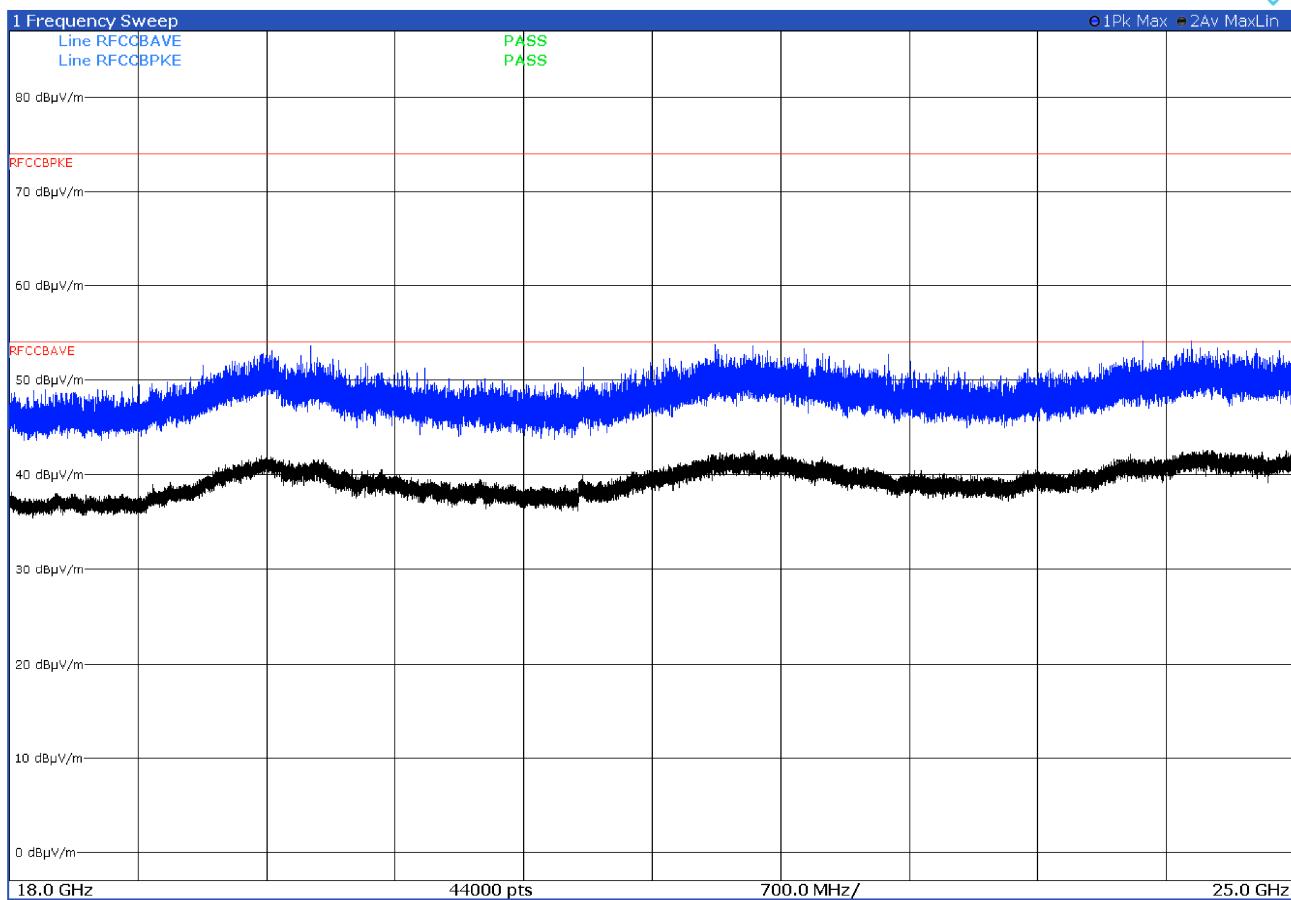


Figure 8.6-15: Radiated spurious emissions on mid channel with antenna in horizontal polarization

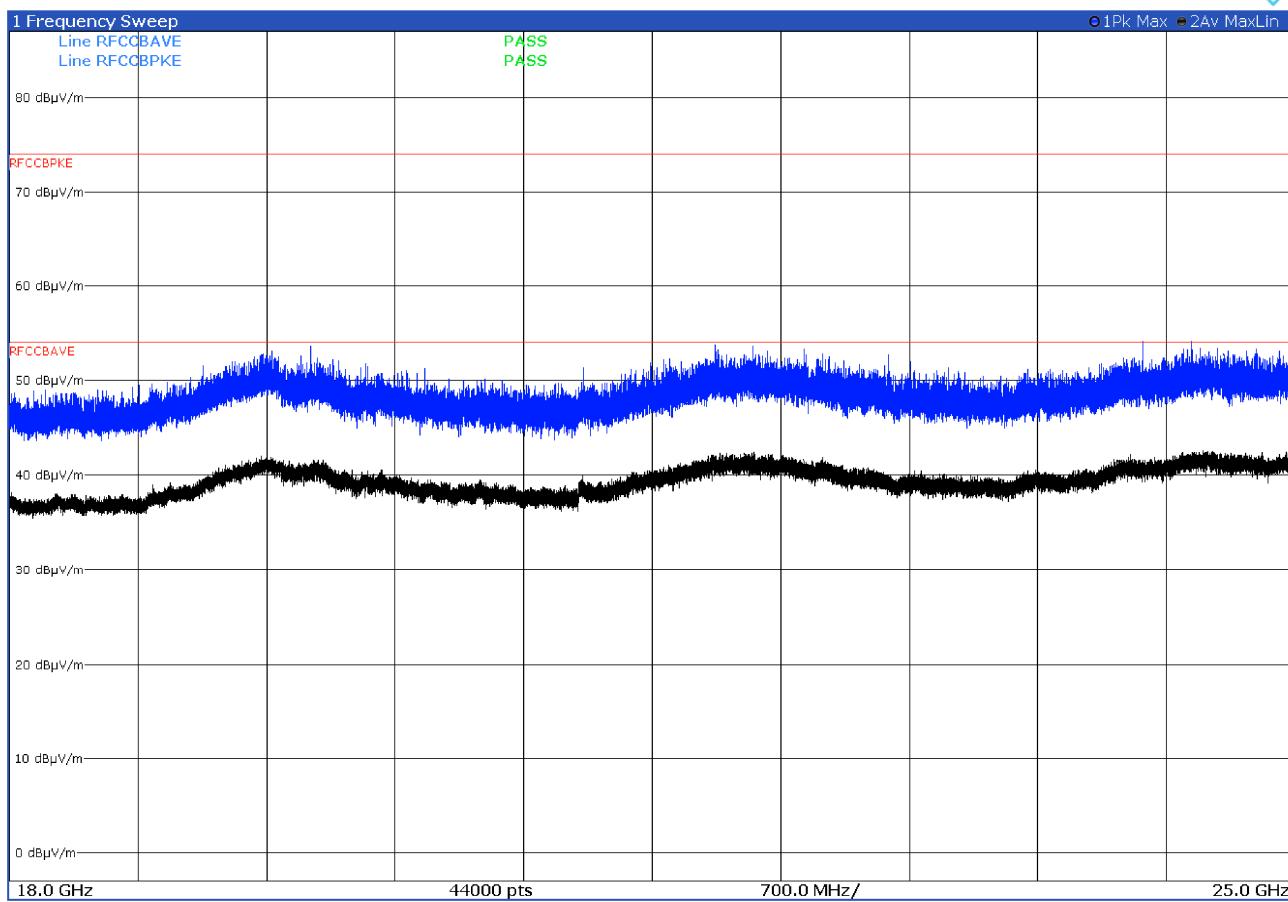
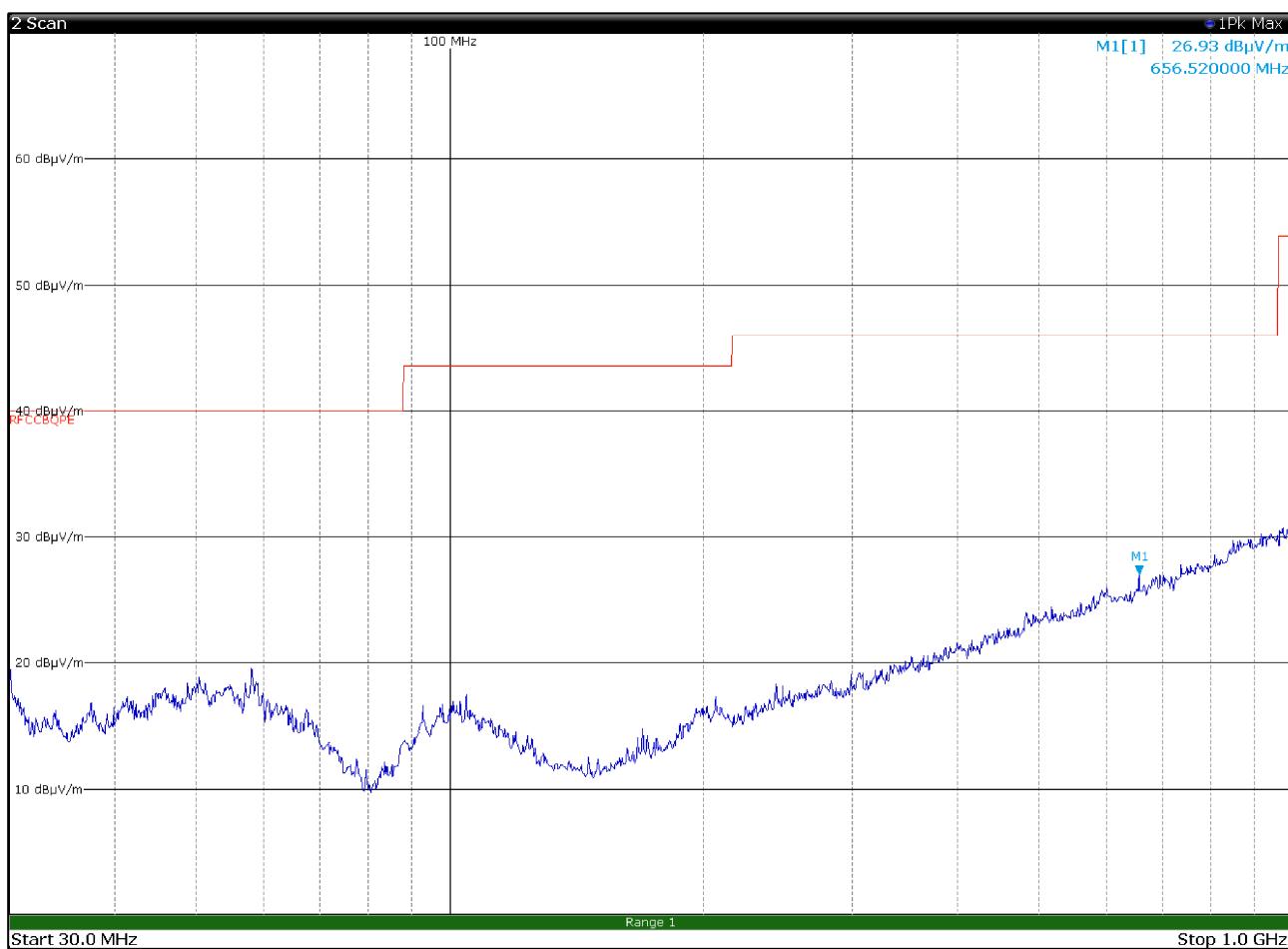


Figure 8.6-16: Radiated spurious emissions on mid channel with antenna in vertical polarization



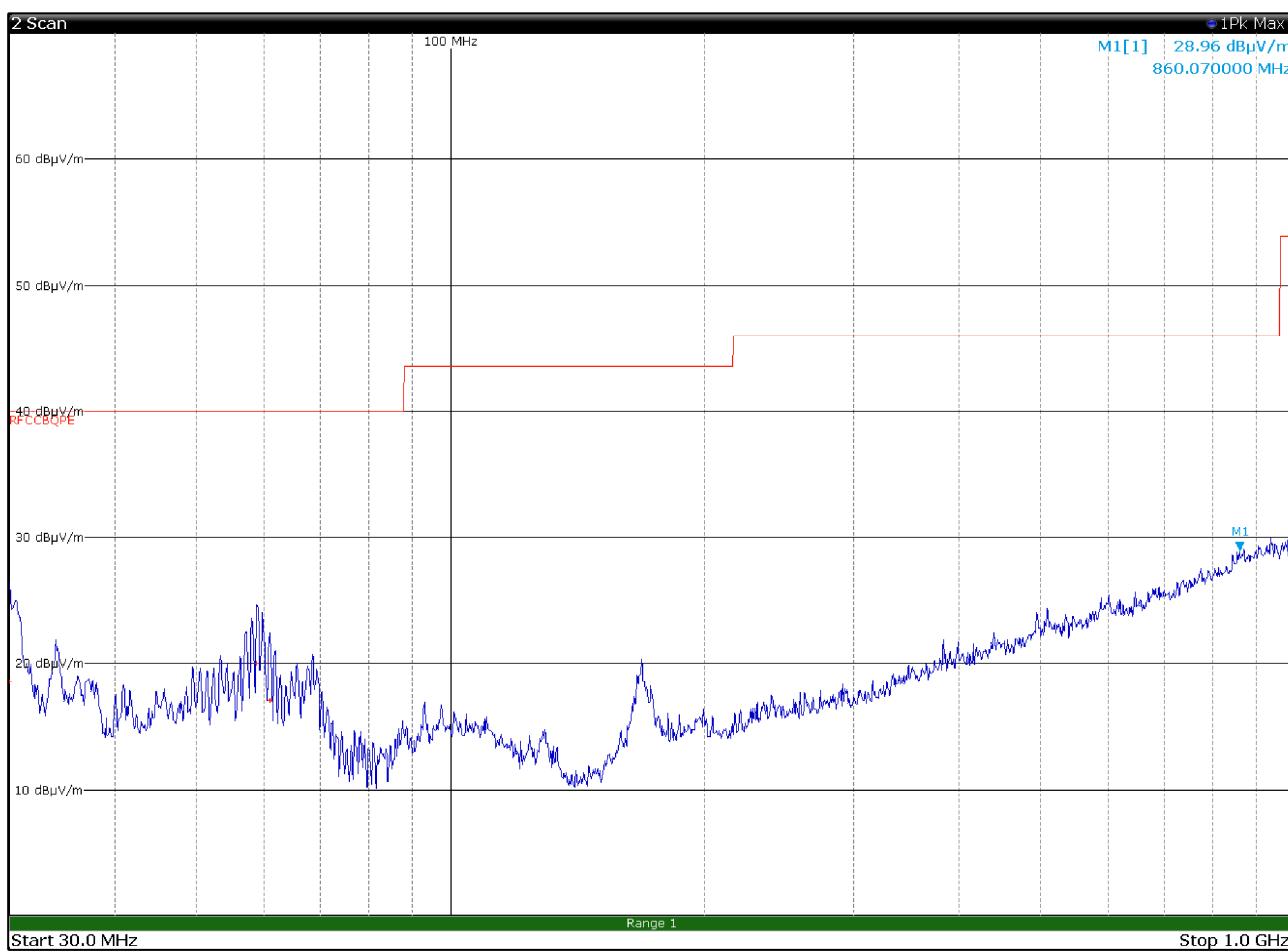
17:07:58 04.05.2021

Page 1/1

Figure 8.6-17: Radiated spurious emissions on high channel with antenna in horizontal polarization

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector
--	--	--	--	--

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.



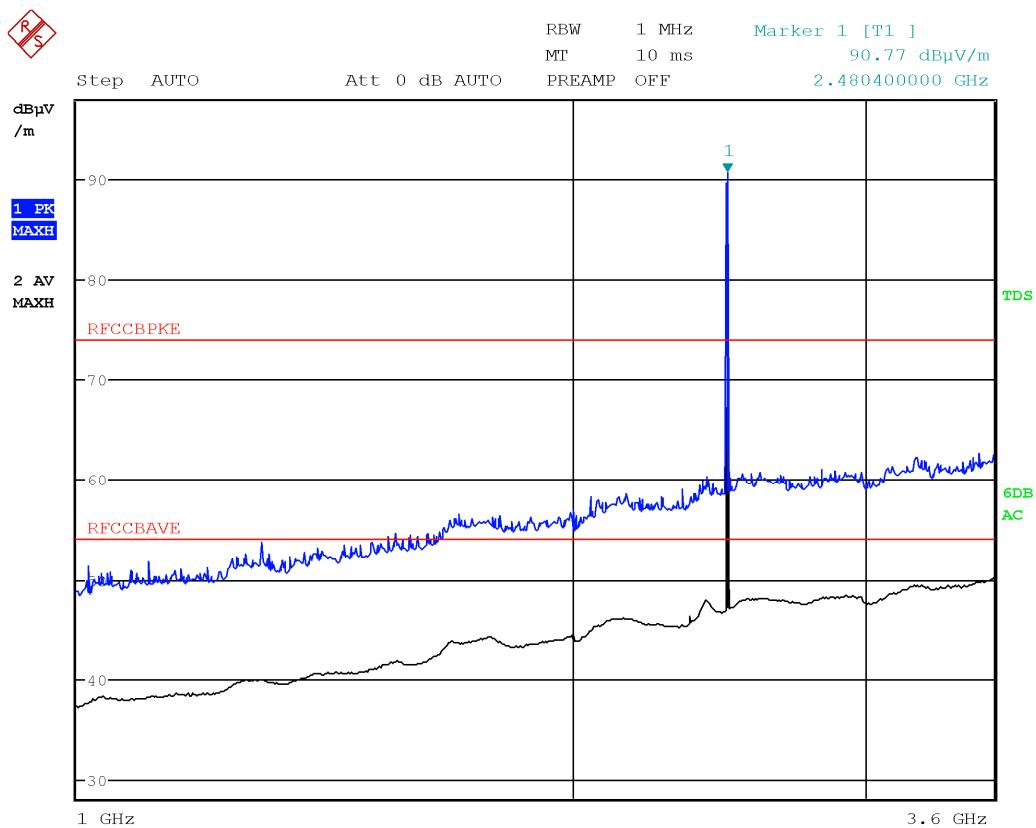
17:04:46 04.05.2021

Page 1/1

Figure 8.6-18: Radiated spurious emissions on high channel with antenna in vertical polarization

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector
30.0000	18.6	40.0	-21.4	QP
58.8600	20.1	40.0	-19.9	QP
60.9900	17.1	40.0	-22.9	QP

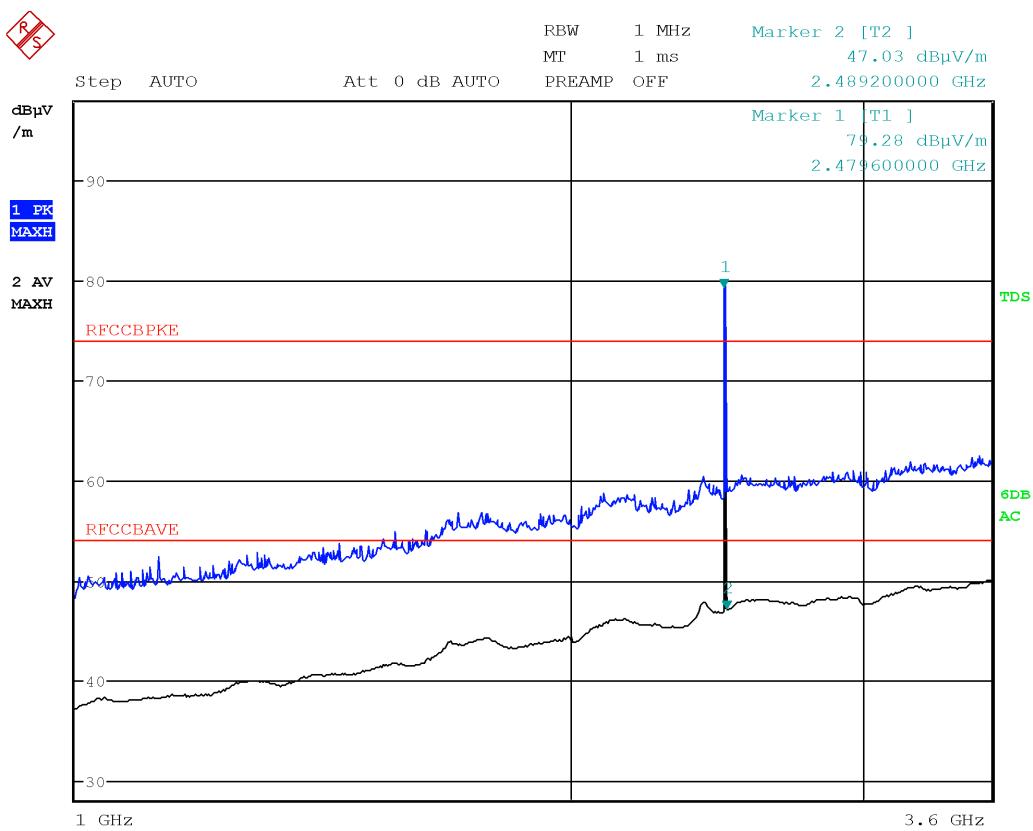
Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.



Date: 5.MAY.2021 19:27:48

Limit exceeded by the carrier

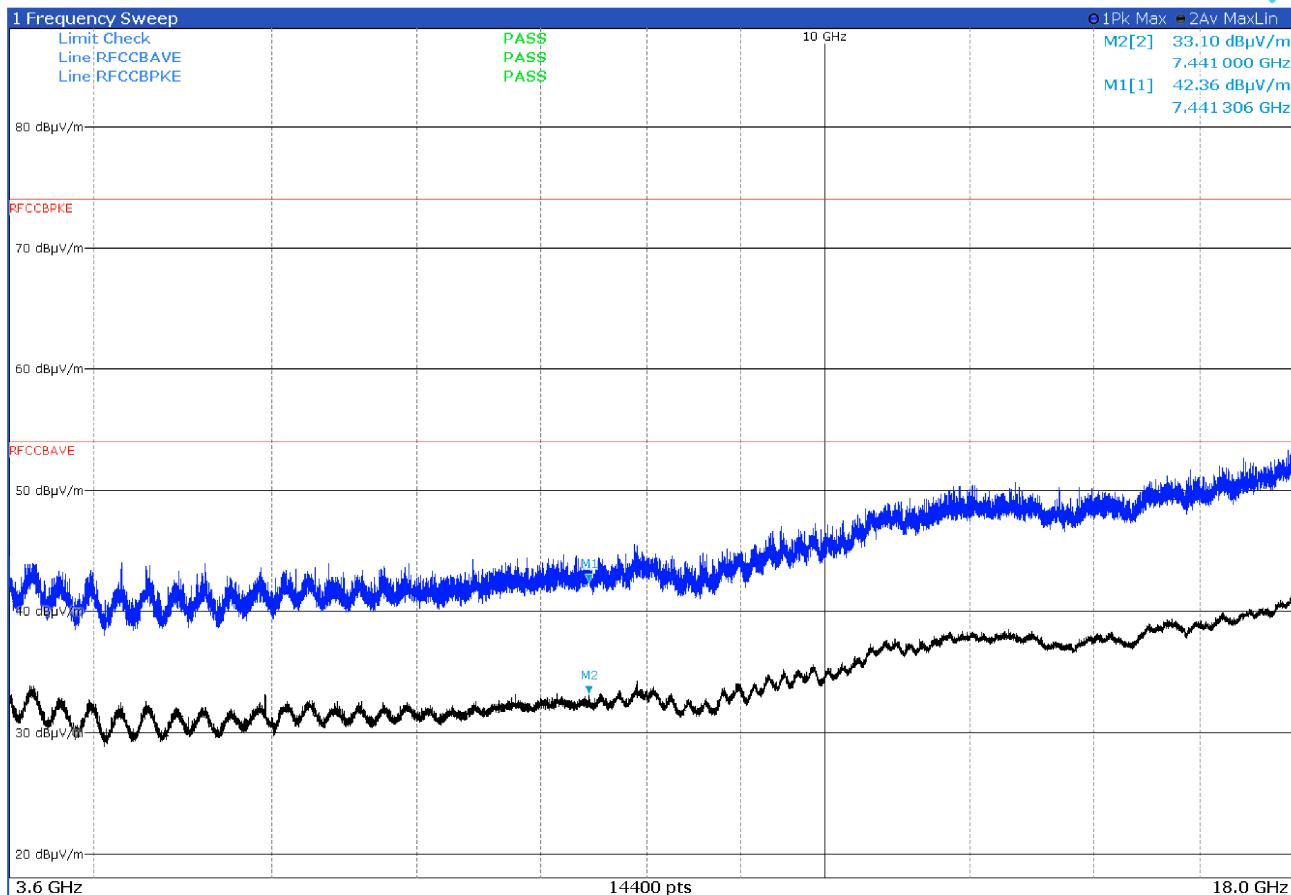
Figure 8.6-19: Radiated spurious emissions on high channel with antenna in horizontal polarization



Date: 5.MAY.2021 19:32:16

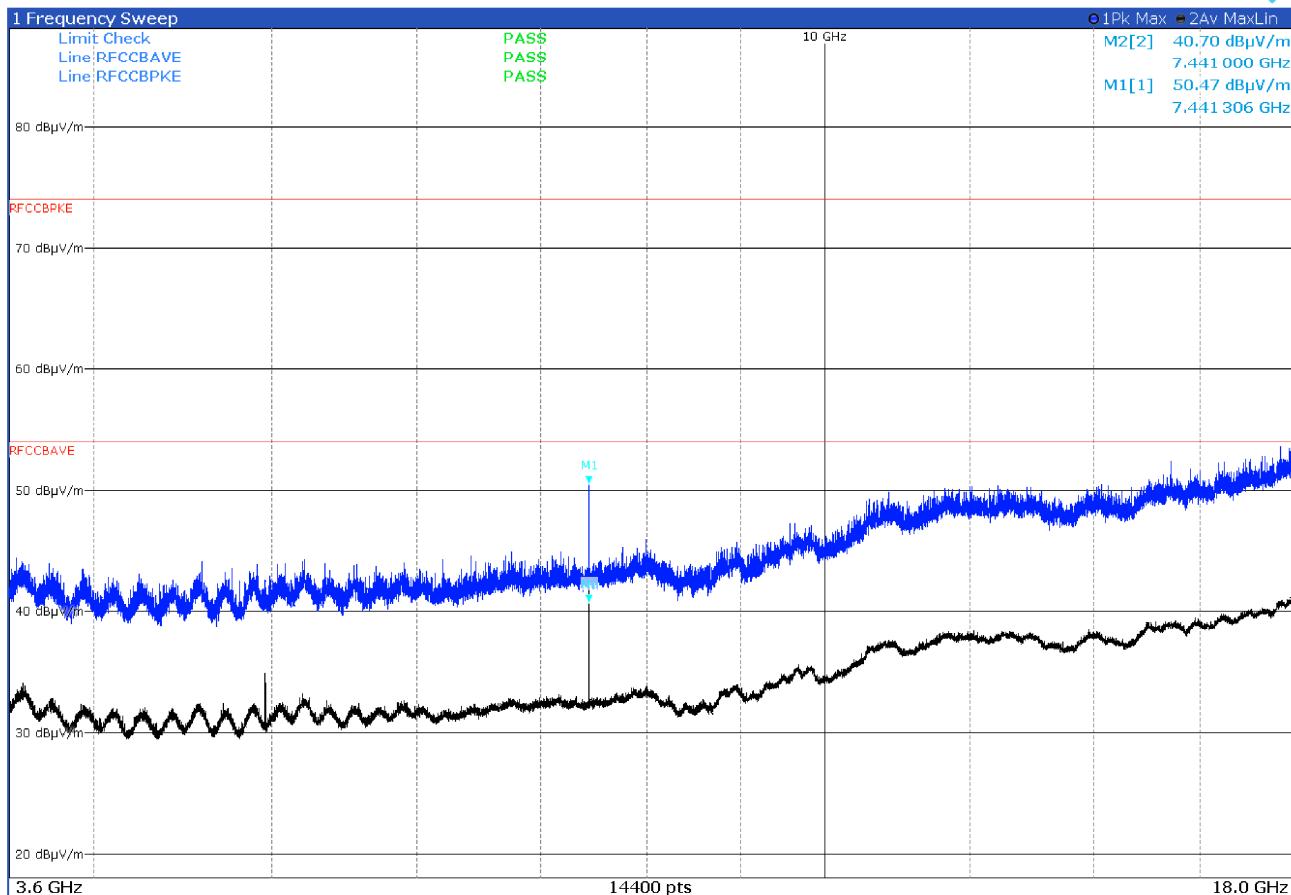
Limit exceeded by the carrier

Figure 8.6-20: Radiated spurious emissions on high channel with antenna in vertical polarization – EUT in horizontal position



Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector
--	--	--	--	--

Figure 8.6-21: Radiated spurious emissions on high channel with antenna in horizontal polarization



Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
7441	60.5	74.0	-13.5	PK
7441	40.7	54.0	-13.3	AV

Figure 8.6-22: Radiated spurious emissions on high channel with antenna in vertical polarization

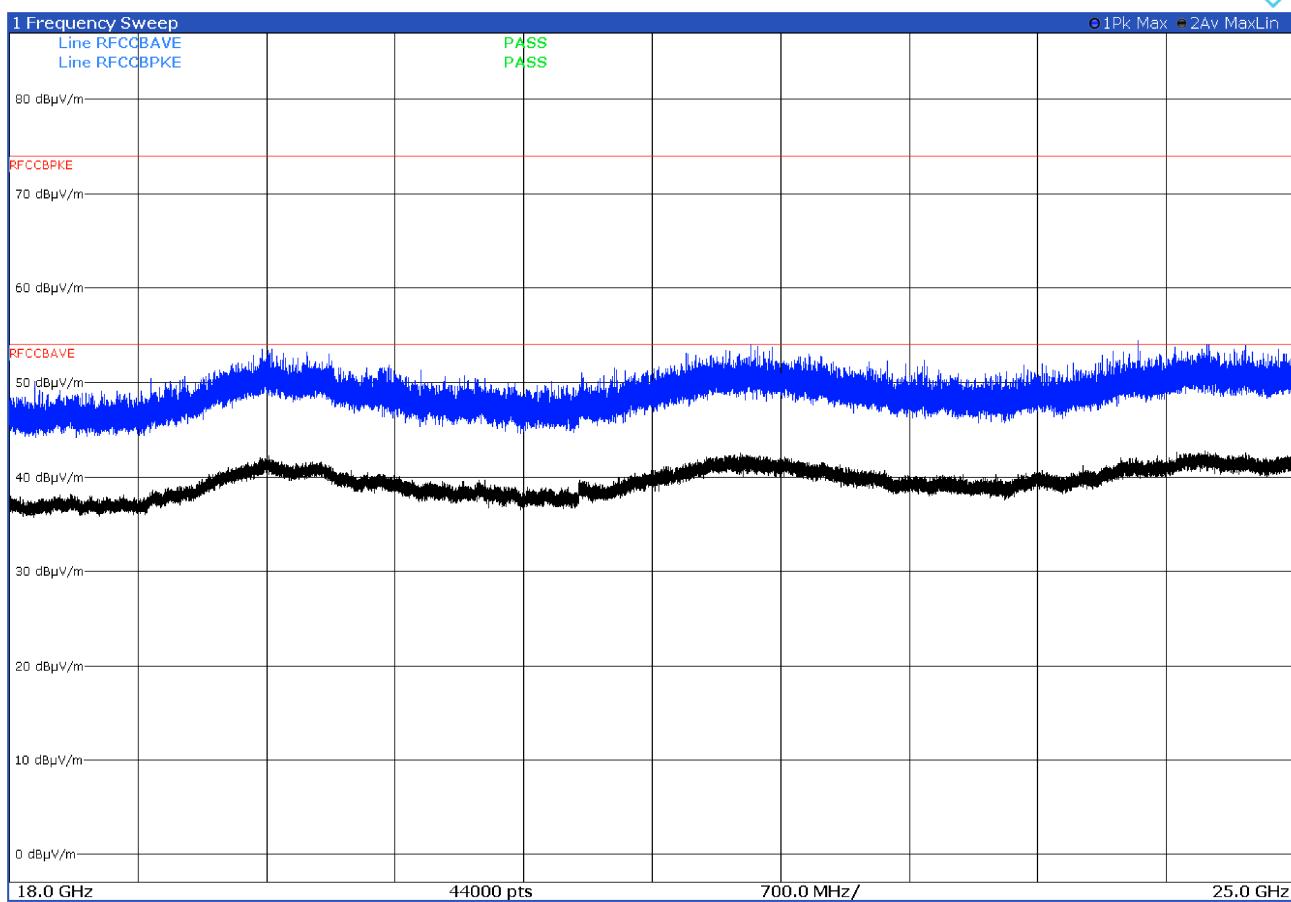
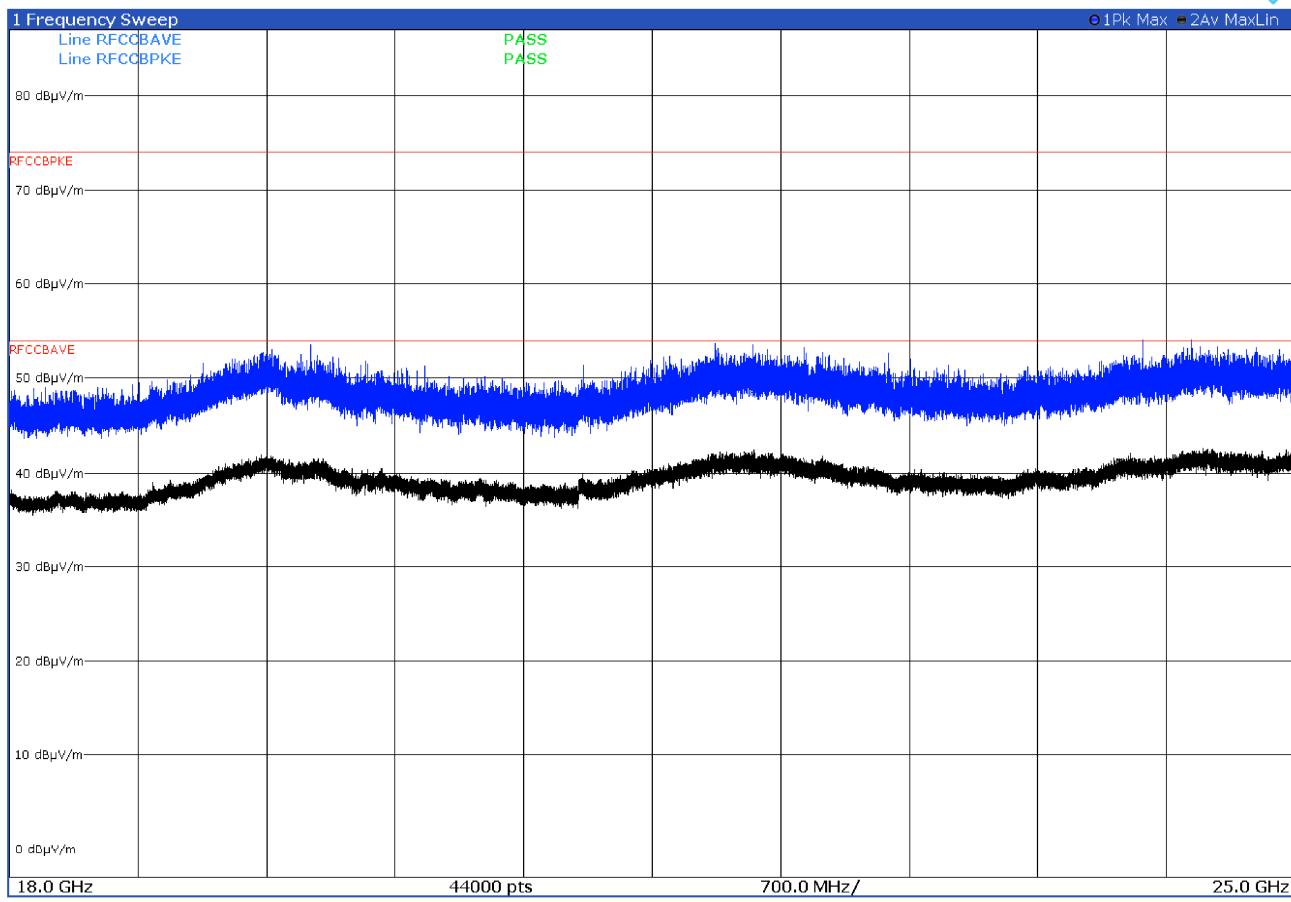


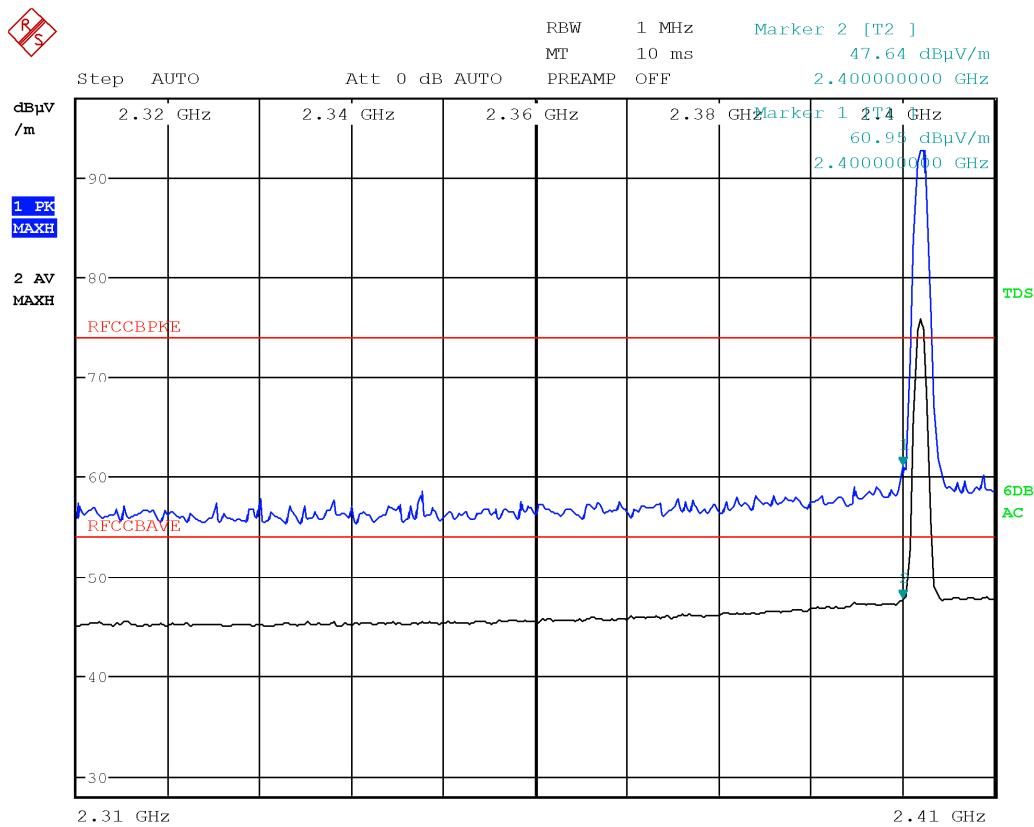
Figure 8.6-23: Radiated spurious emissions on high channel with antenna in horizontal polarization



16:55:35 26.05.2021

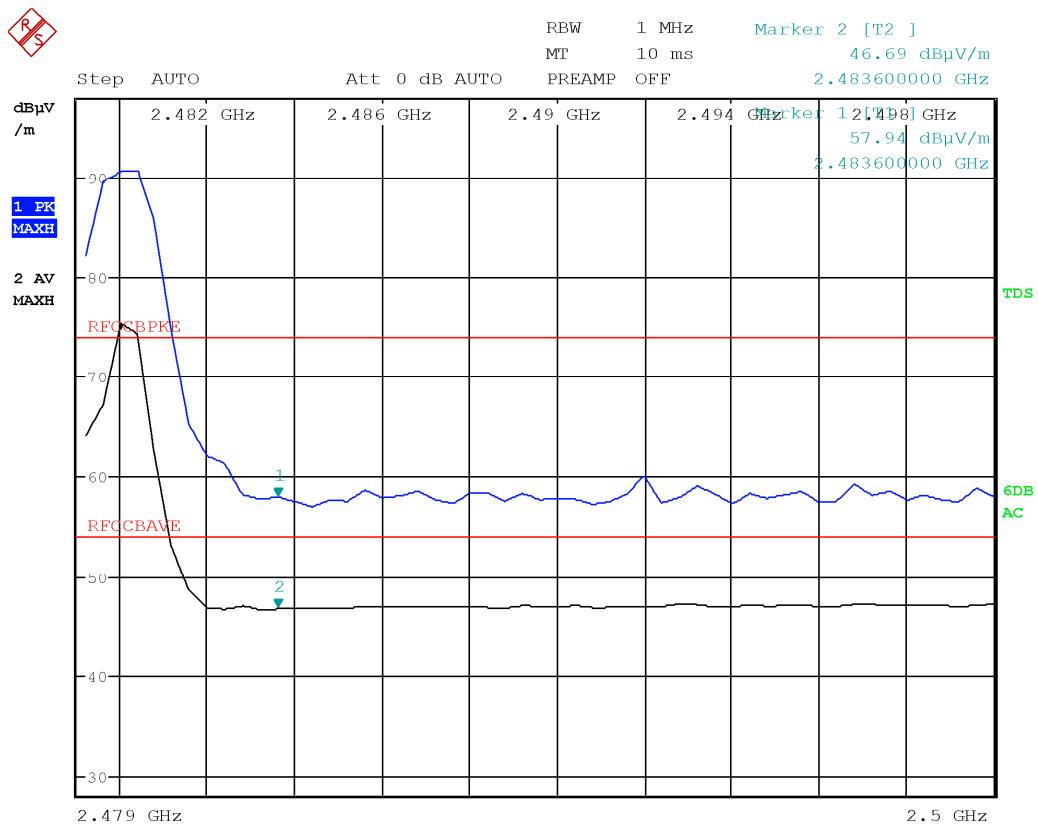
Page 1/1

Figure 8.6-24: Radiated spurious emissions on high channel with antenna in vertical polarization



Date: 5.MAY.2021 19:15:57

Figure 8.6-25: Band edge spurious emissions at 2400 MHz for restricted frequency bands



Date: 5.MAY.2021 19:28:52

Figure 8.6-26: Band edge spurious emissions at 2483.5 MHz for restricted frequency bands

8.7 Power spectral density for digitally modulated devices

8.7.1 References, definitions and limits

FCC §15.247:

(e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

(f) For the purposes of this section, hybrid systems are those that employ a combination of both frequency hopping and digital modulation techniques. The frequency hopping operation of the hybrid system, with the direct sequence or digital modulation operation turned-off, shall have an average time of occupancy on any frequency not to exceed 0.4 seconds within a time period in seconds equal to the number of hopping frequencies employed multiplied by 0.4. The power spectral density conducted from the intentional radiator to the antenna due to the digital modulation operation of the hybrid system, with the frequency hopping operation turned off, shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

8.7.2 Test summary

Verdict	Pass				
Tested by	D. Guarnone	Test date	May 5, 2021	436	4366730002

8.7.3 Observations, settings and special notes

Power spectral density test was performed as per KDB 558074, section 8.4 with reference to ANSI C63.10 subclause 11.10.

The test was performed using method PKPSD (peak PSD).

Spectrum analyser settings:

Resolution bandwidth:	3 kHz
Video bandwidth:	$\geq 3 \times \text{RBW}$
Frequency span:	1.5 times the DTS BW (Peak)
Detector mode:	Peak
Trace mode:	Max hold

8.7.4 Test equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
EMI receiver (20 Hz ÷ 8 GHz)	Rohde & Schwarz	ESU8	100202	08/2020	08/2021
Controller	Maturo	FCU3.0	10041	NCR	NCR
Tilt antenna mast	Maturo	TAM4.0-E	10042	NCR	NCR
Turntable	Maturo	TT4.0-5T	2.527	NCR	NCR
Semi-anechoic chamber	Nemko	10m semi-anechoic chamber	530	09/2019	09/2021
Shielded room	Siemens	10m control room	1947	NCR	NCR

8.7.5 Test data

Table 8.7-1: PSD results

Output power was calculated as follows:

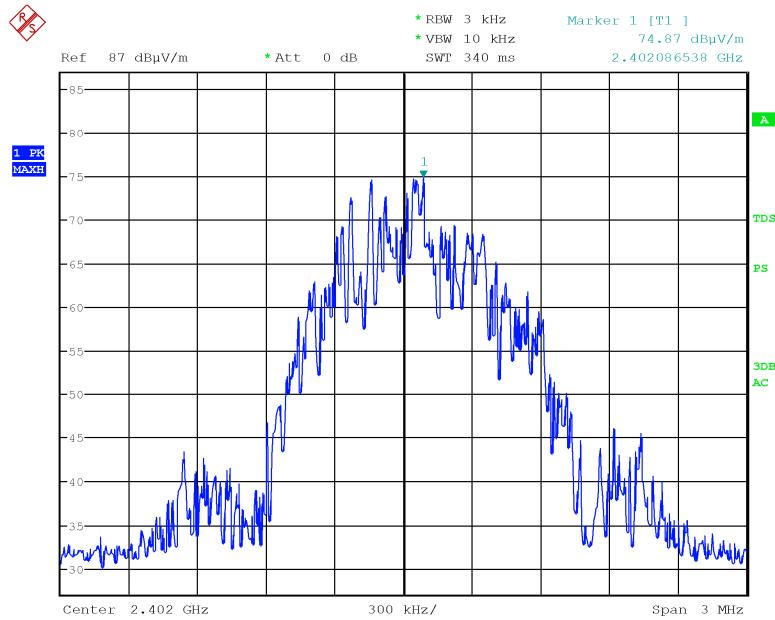
0 dBm eirp are 95.2 dBuV/m at 3m:

Vertical polarization

Modulation	Frequency, MHz	PSD dBm/3kHz	PSD dBm/ 3kHz	margin dB	Antenna gain, dBi	EIRP, dBm/3 kHz	E Field dBuV/m /3 kHz
BLE	2402	-30.65	8	-38.65	1.1	-29.55	65.65
	2440	-32.22	8	-40.22	1.1	-31.12	64.08
	2480	-31.47	8	-39.47	1.1	-30.37	64.83

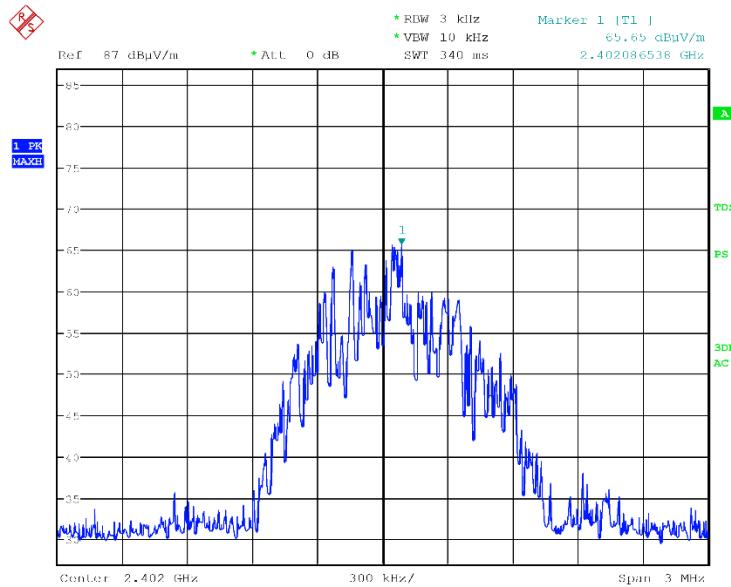
Horizontal polarization

Modulation	Frequency, MHz	PSD dBm/3kHz	PSD dBm/3kHz	margin dB	Antenna gain, dBi	EIRP, dBm/3 kHz	E Field dBuV/m /3 kHz
BLE	2402	-21.43	8	-29.43	1.1	-20.33	74.87
	2440	-24.69	8	-32.69	1.1	-23.59	71.61
	2480	-23.93	8	-31.93	1.1	-22.83	72.37



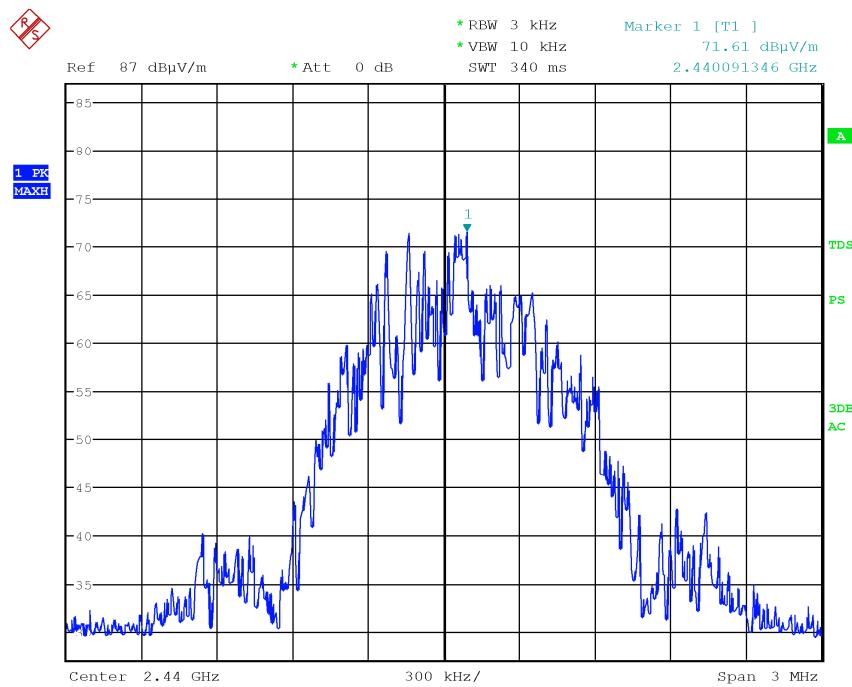
Date: 5.MAY.2021 19:19:12

Figure 8.7-1: PSD on low channel, horizontal polarization



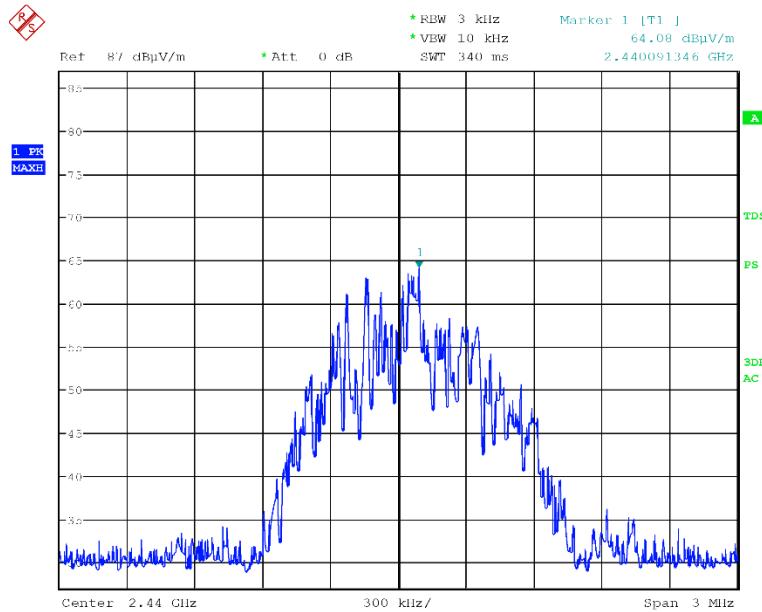
Date: 5.MAY.2021 19:20:33

Figure 8.7-2: PSD on low channel, vertical polarization



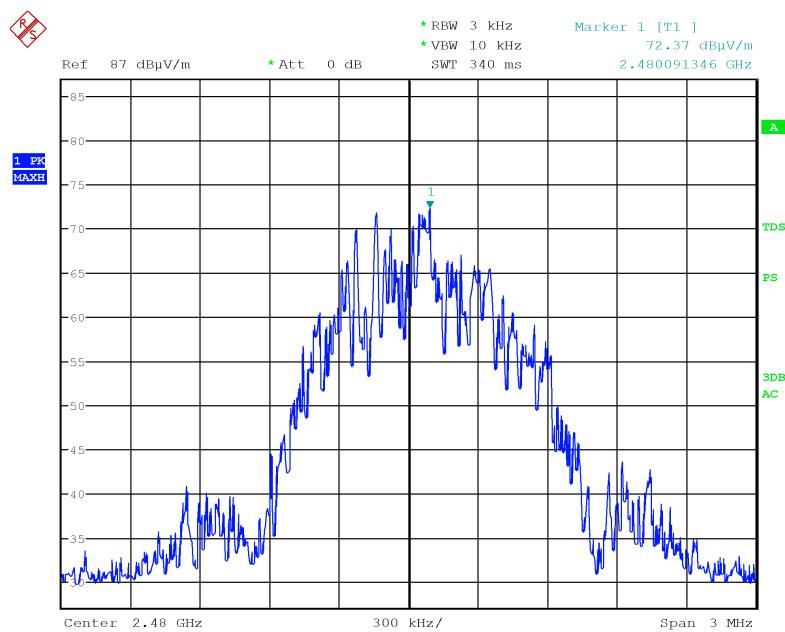
Date: 5.MAY.2021 19:37:28

Figure 8.7-3: PSD on mid channel, horizontal polarization



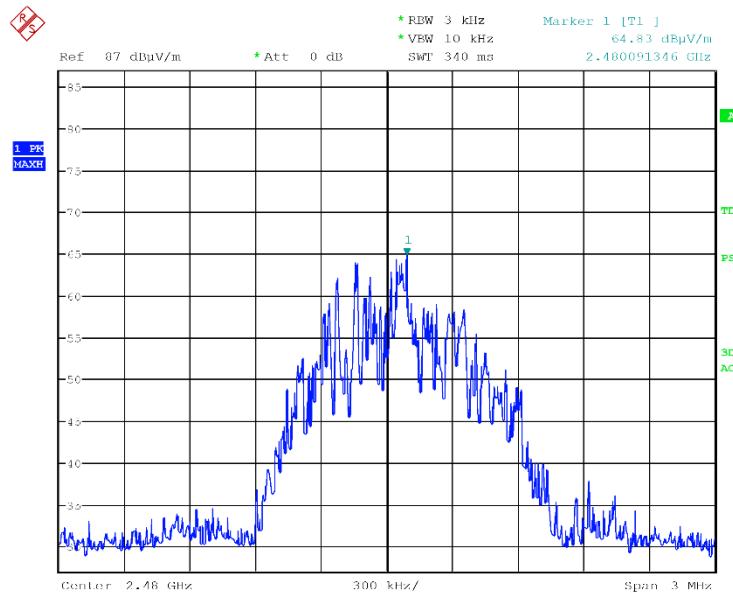
Date: 5.MAY.2021 19:38:33

Figure 8.7-4: PSD on mid channel, vertical polarization



Date: 5.MAY.2021 19:25:22

Figure 8.7-5: PSD on high channel, horizontal polarization



Date: 5.MAY.2021 19:23:41

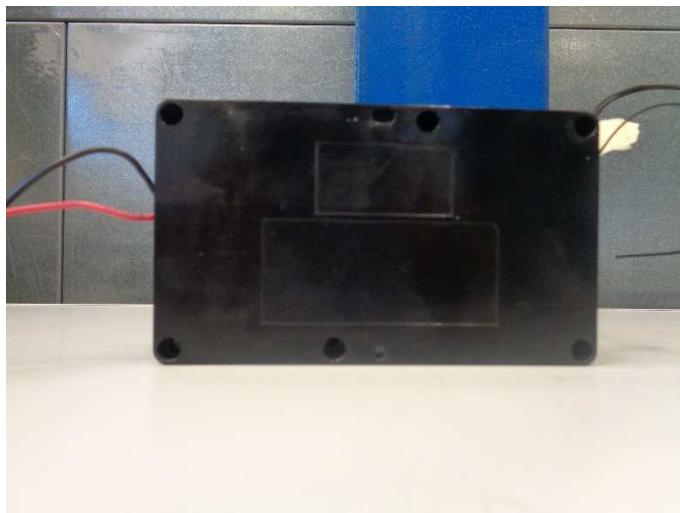
Figure 8.7-6: PSD on high channel, vertical polarization

Section 9 EUT photos

9.1 External photos



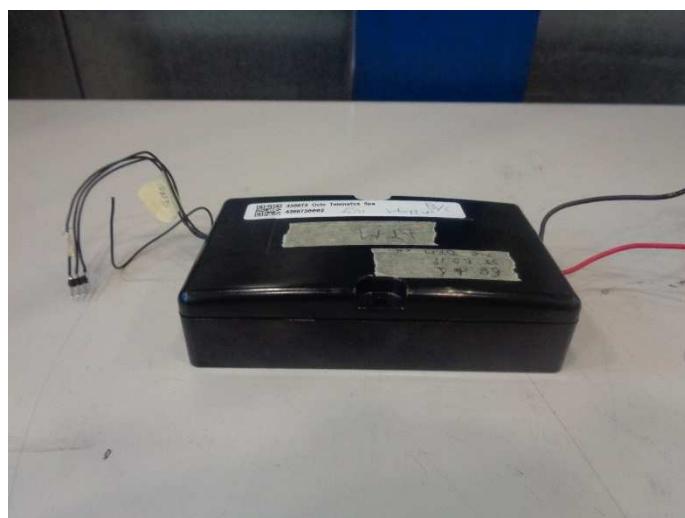
Top view photo



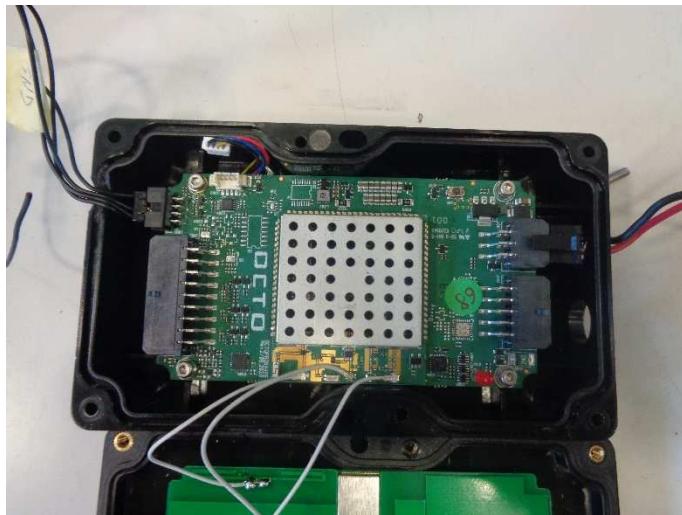
Bottom view photo



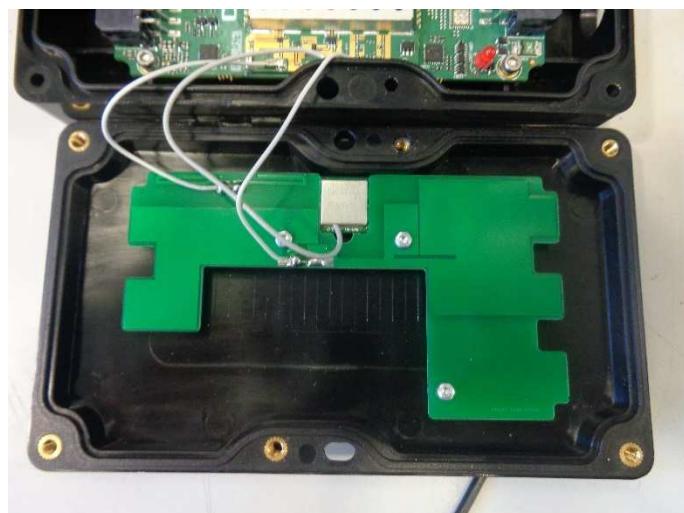
Lateral view photo



Lateral view photo



Internal view photo



Internal view photo

9.2 Set-up photos



Figure 9.2-1: Radiated emission testing below 1 GHz

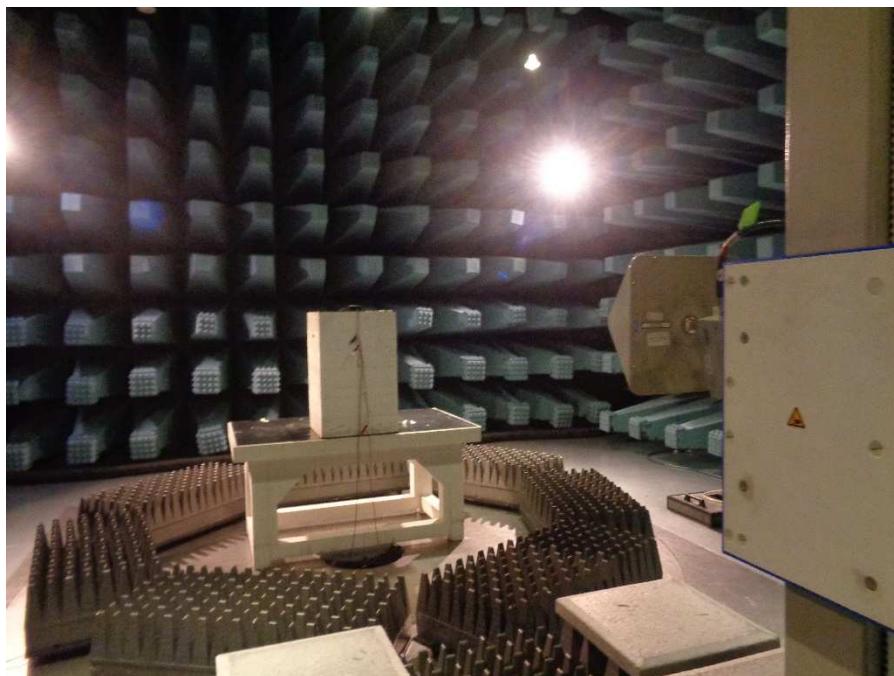


Figure 9.2-2: Radiated emission testing above 1 GHz

End of the test report