

RADIO TEST REPORT – 474474-4TRFWL

Type of assessment:

Final product testing

Applicant:

Favero Electronics Srl

Via R. Lombardi, 64 – 31030 Arcade (TV) – Italy

Product:

Sensor

Model:

F-PM2

FCC ID:

2ATKD-FPM2

Specifications:

◆ **FCC 47 CFR Part 15 Subpart C, §15.249**

Date of issue: October 3, 2022

P. Barbieri

Tested by



Signature

D. Guarnone

Reviewed by



Signature

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Doc. n. TRF001; Rev. 0; Date: 2020-11-30

Lab locations

Company name	Nemko Spa
Address	Via del Carroccio, 4
City	Biassono
Province	MB
Postal code	20853
Country	Italy
Telephone	+39 039 220 12 01
Facsimile	+39 039 220 12 21
Website	www.nemko.com
Site number	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 contain in this report are within Nemko Spa ISO/IEC 17025 accreditation.

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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/Manufacture	8
5.3 EUT information	8
5.4 Radio technical information	9
5.5 EUT setup details	10
Section 6 Summary of test results	13
6.1 Testing location	13
6.2 Testing period	13
6.3 Sample information	13
6.4 FCC Part 15 Subpart A and C, general requirements test results	13
6.5 FCC Part §15.249 test results for intentional radiators	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 20 dB bandwidth	19
8.5 Field strength of fundamental	22
8.6 Spurious (out-of-band) unwanted emissions	24
Section 9 EUT photos	35
9.1 Set-up photos	35
9.2 External photos	36

Section 1 Report summary

1.1 Test specifications

FCC 47 CFR Part 15, Subpart C, Clause 15.249	Operation in the 902–928 MHz, 2400–2483.5 MHz, 5725–5875 MHz and 24.0–24.25 GHz
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1.2 Test methods

ANSI C63.10 v2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
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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
474474-4TRFWL	October 3, 2022	Original report issued

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

Temperature	15 °C – 35 °C
Relative humidity	20 % – 75 %
Air pressure	86 kPa (860 mbar) – 106 kPa (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	2020-12	2022-12
Thermo-hygrometer data loggers	Testo	175-H2	38203337/703	2020-12	2022-12
Barometer	Castle	GPB 3300	072015	2022-04	2023-04

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)
		Carrier power RF Output Power	0.009 MHz ÷ 30 MHz	1.1 dB	(1)
			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)
		Conducted spurious emissions	0.009 MHz ÷ 18 GHz	3.0 dB	(1)
			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)
		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	Radiated spurious emissions	0.009 MHz ÷ 26.5 GHz	6.0 dB	(1)
			26.5 GHz ÷ 66 GHz	8.0 dB	(1)
			66 GHz ÷ 220 GHz	10 dB	(1)
		Effective radiated power transmitter	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.

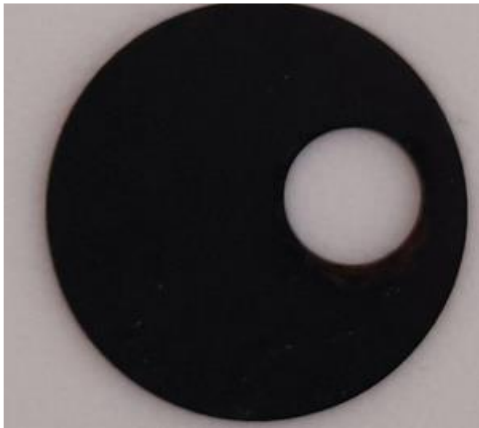
5.2 Applicant/Manufacture

Applicant name	Favero Electronics Srl
Applicant address	Via R. Lombardi, 64 – 31030 Arcade (TV) – Italy
Manufacture name	Same as applicant
Manufacture address	Same as applicant

5.3 EUT information

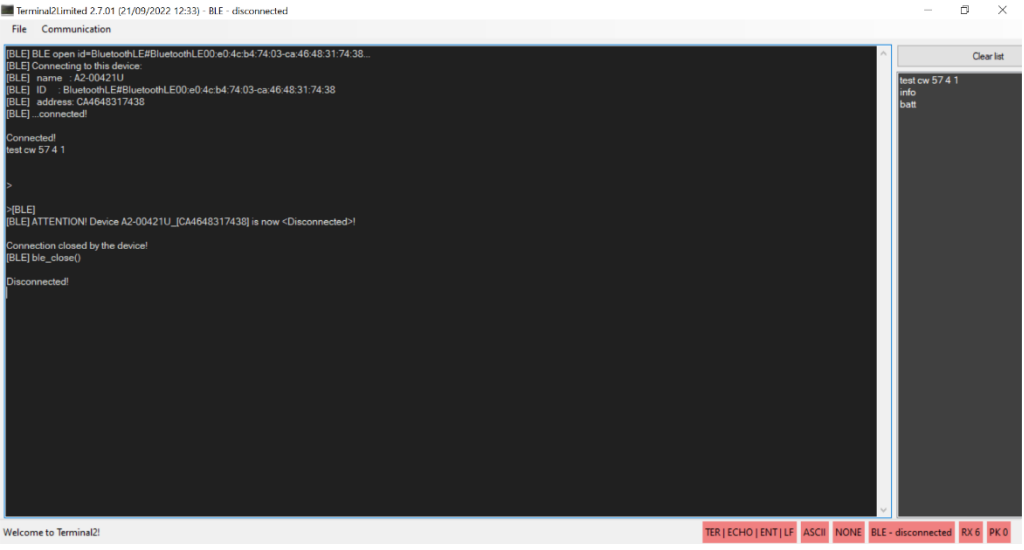
Product	Sensor
Model	F-PM2
Model variant(s)	--
Serial number	EUT with integrated antenna: 4744740002 (Number assigned by Nemko Spa) EUT with temporary antenna connector: 4744740003 (Number assigned by Nemko Spa)
Power supply requirements	3.7 V DC from internal Lithium battery 5 V DC from USB line (recharging)
Product description and theory of operation	The EUT is an electronic sensor that can be used to make a power meter for cycling. The sensor contains an electronic board with a Nordic Semiconductor nRF52840 transceiver integrated circuit, to which a custom antenna made with a circular flexible circuit is connected.

5.4 Radio technical information

Frequency band	2400–2483.5 MHz
Frequency (MHz)	2457 MHz
Channel numbers	1
RF power Max (W), Conducted	N/A
Field strength, dB μ V/m @ 3 m	93.0 dB μ V/m
Measured BW (kHz), 99% OBW	938 kHz
Type of modulation	FSK
Emission classification	F7D
Transmitter spurious, dB μ V/m @ 3 m	52.3 dB μ V/m Average
Antenna information	Custom antenna (flexible PCB diskette with unknown gain)
	

5.5 EUT setup details

5.5.1 Radio exercise details

Operating conditions	The EUT has been tested in continuous transmission mode with the following software.  The power level has been set to 4 according to applicant's request.
Transmitter state	Transmitter set into continuous mode.

5.5.2 EUT setup configuration

Table 5.5-1: EUT sub assemblies

Description	Brand name	Model, Part number, Serial number, Revision level
--	--	--

The EUT is composed by a single unit

Table 5.5-2: EUT interface ports

Description	Qty.
None	--

The EUT is supplied by internal battery with two recharging pins used only for recharge the battery

Table 5.5-3: Support equipment

Description	Brand name	Model, Part number, Serial number, Revision level
Notebook	Dell	Latitude 7480

Table 5.5-4: Inter-connection cables

Cable description	From	To	Length (m)
Temporary antenna connector	EUT	Spectrum analyzer	0.15

The EUT has been modified with a temporary antenna connector. The following cable is not normally connected

EUT setup configuration, continued

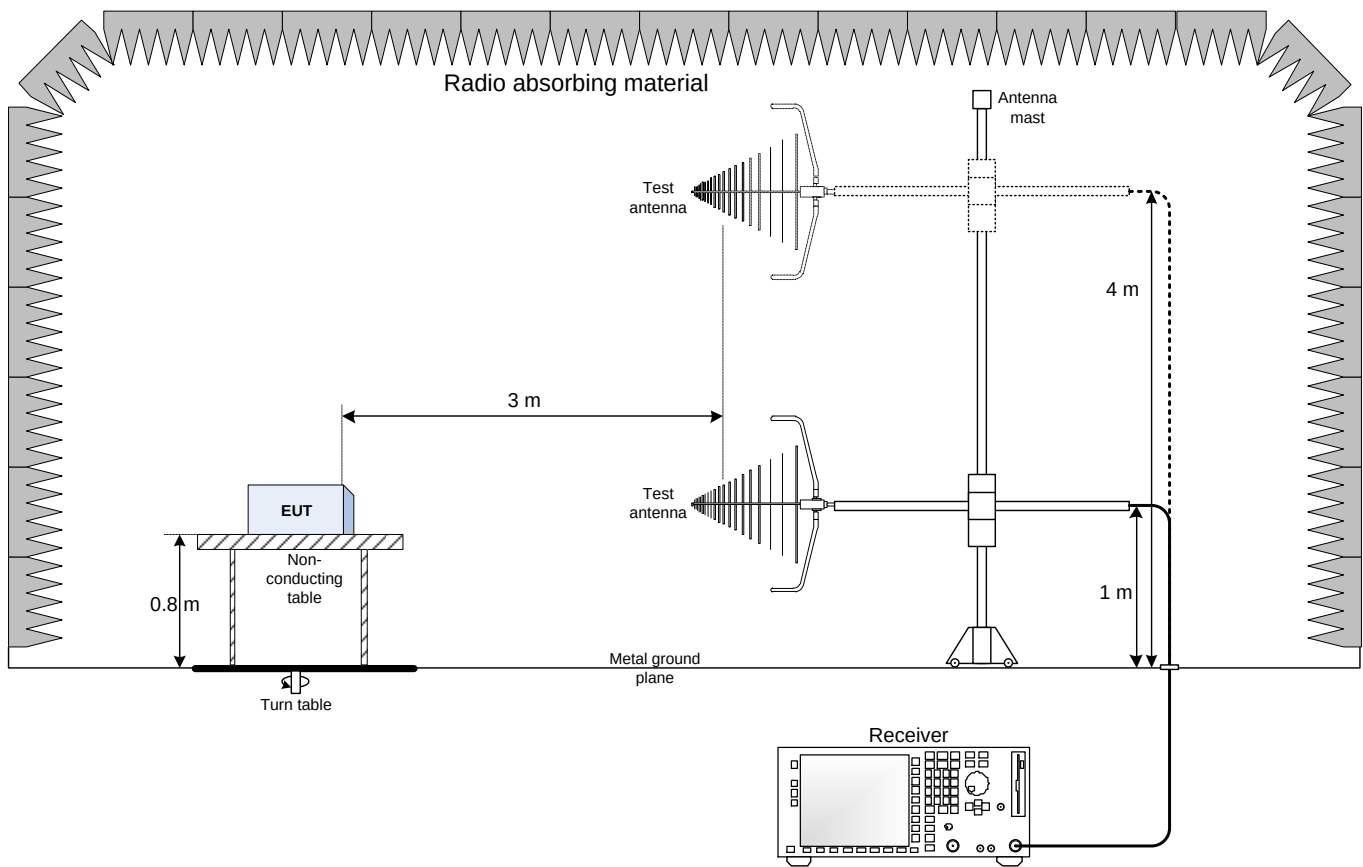


Figure 5.5-1: Radiated testing below 1 GHz block diagram

EUT setup configuration, continued

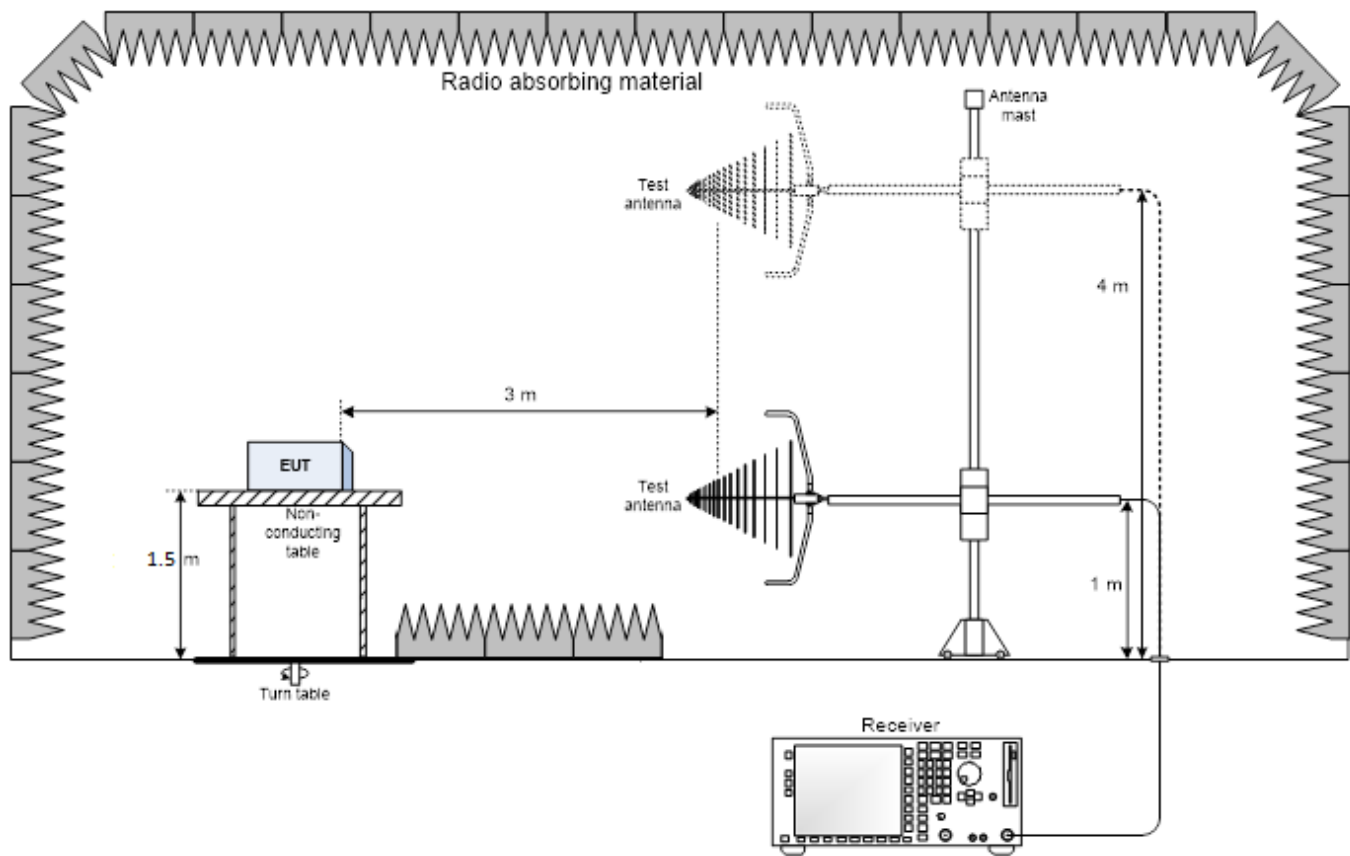


Figure 5.5-2: Radiated testing above 1 GHz block diagram

Section 6 Summary of test results

6.1 Testing location

Test location (s) Nemko Spa

6.2 Testing period

Test start date September 22, 2022 Test end date October 3, 2022

6.3 Sample information

Receipt date August 8, 2022 Nemko sample ID number(s) 474474

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
§15.31I	Variation of power source	Pass
§15.31(m)	Number of tested frequencies	Pass
§15.203	Antenna requirement	Pass
§15.215(c)	20 dB emission bandwidth	Pass

Notes: EUT is a battery operated device, the testing was performed using full charged battery.

6.5 FCC Part §15.249 test results for intentional radiators

Table 6.5-1: FCC intentional radiators requirements results

Part	Test description	Verdict
§15.249(a)	Field strength of fundamental and harmonics emissions	Pass
§15.249(d)	Spurious emissions radiated outside of the specified frequency bands, except for harmonics	Pass

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.
Spectrum Analyzer	Rohde & Schwarz	FSW43	101767	2021-12	2022-12
EMI Receiver	Rohde & Schwarz	ESW44	101620	2022-08	2023-08
Antenna Trilog 25MHz - 8GHz	Schwarzbeck Mess-Elektronik	VULB9162	9162-025	2021-07	2024-07
Antenna 1 - 18 GHz	Schwarzbeck Mess-Elektronik	STLP9148	STLP 9148-152	2021-09	2024-09
Double Ridge Horn Antenna	RFSpin	DRH40	061106A40	2020-04	2023-04
Broadband Amplifier	Schwarzbeck Mess-Elektronik	BBV9718C	00121	2022-03	2023-03
Broadband Bench Top Amplifier	Sage	STB-1834034030-KFKF-L1	18490-01	2022-05	2023-05
Controller	Maturo	FCU3.0	10041	NCR	NCR
Tilt antenna mast	Maturo	TAM4.0-E	10042	NCR	NCR
Turntable	Maturo	TT4.0-ST	2.527	NCR	NCR
Semi-anechoic chamber	Nemko S.p.a.	10m semi-anechoic chamber	530	2021-09	2023-09

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	P. Barbieri	Test date	September 22, 2022
Sample tested	4744740002		

8.1.3 Observations, settings and special notes

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

- 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.
- 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.
- 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.
- 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:

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

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	P. Barbieri	Test date	September 22, 2022
Sample tested	4744740002		

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	--	2457	--

The EUT use only one frequency

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.

8.3.2 Test summary

Verdict	Pass		
Tested by	P. Barbieri	Test date	September 22, 2022
Sample tested	4744740002		

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	Average gain	Connector type
Flexible PCB diskette	Custom antenna	Custom antenna	Unknown gain	--

8.4 20 dB bandwidth

8.4.1 References, definitions and limits

FCC §15.215:

- (c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. In the case of intentional radiators operating under the provisions of subpart E, the emission bandwidth may span across multiple contiguous frequency bands identified in that subpart. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

8.4.2 Test summary

Verdict	Pass		
Tested by	P. Barbieri	Test date	October 3, 2022
Sample tested	4744740003		

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	1–5% of OBW
Video bandwidth	$\geq 3 \times \text{RBW}$
Frequency span	3 MHz
Detector mode	Peak
Trace mode	Max Hold

8.4.4 Test equipment used

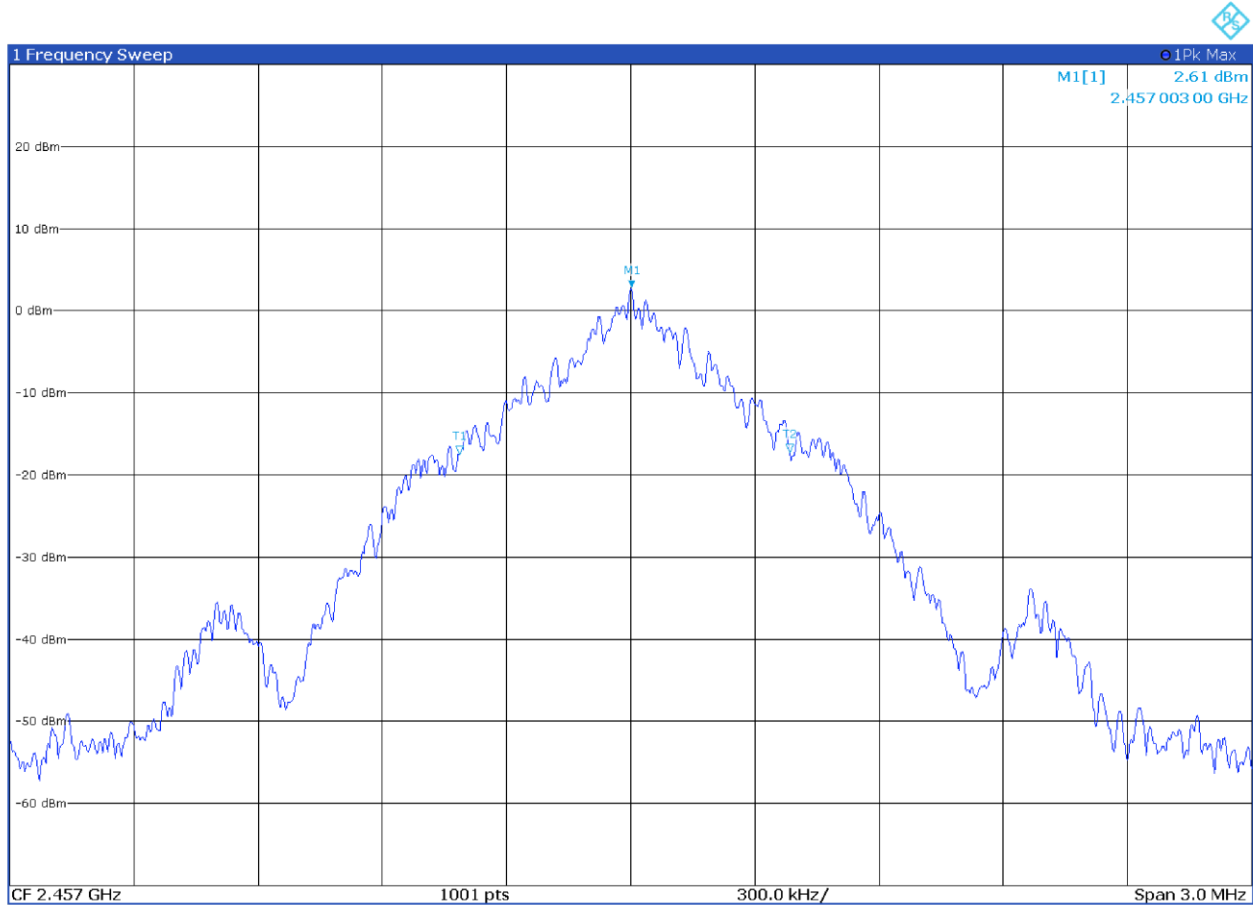
Equipment	Manufacturer	Model no.	Asset no.
Spectrum Analyzer	Rohde & Schwarz	FSW43	101767

8.4.5 Test data

Table 8.4-1: 20 dB bandwidth results

Modulation	Frequency, MHz	20 dB bandwidth, kHz
FSK	2457	797.2

Note: the 20 dB bandwidth fall within the assigned band.



Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	2.457 003 GHz	2.61 dBm	ndB	20.0 dB
T1		1	2.456 586 4 GHz	-17.46 dBm	ndB down BW	797.20 kHz
T2		1	2.457 383 6 GHz	-17.32 dBm	Q Factor	3082.0

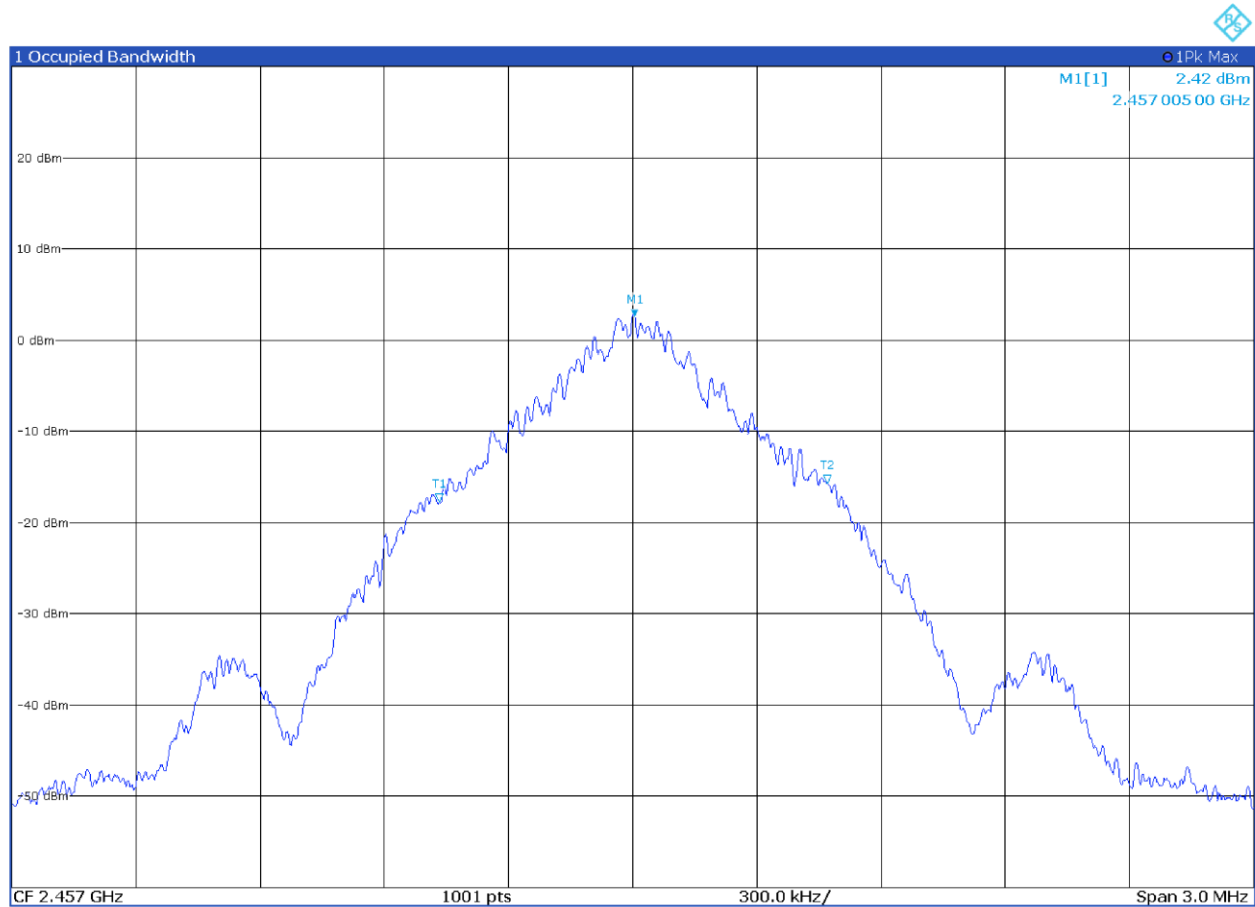
Figure 8.4-1: 20 dB bandwidth

Test data, continued

Table 8.4-2: 99% occupied bandwidth results

Modulation	Frequency, MHz	99% occupied bandwidth, kHz
FSK	2457	938.0

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



Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	2.457 005 GHz	2.42 dBm	Occ Bw	938.000 381 54 kHz
T1		1	2.456 531 81 GHz	-17.75 dBm	Occ Bw Centroid	2.457 000 814 GHz
T2		1	2.457 469 81 GHz	-15.75 dBm	Occ Bw Freq Offset	814.065 026 283 Hz

Figure 8.4-2: 99% occupied bandwidth

8.5 Field strength of fundamental

8.5.1 References, definitions and limits

FCC §15.249:

- (a) The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Table 8.5-1: Field strength limits

Fundamental frequencies (MHz)	Field strength of fundamental		Field strength of harmonics	
	(mV/m)	(dBμV/m)	(μV/m)	(dBμV/m)
902–928	50	94	500	54
2400–2483.5	50	94	500	54
5725–5875	50	94	500	54
24.0–24.25*	250	108	2500	68

- (c) Field strength limits are specified at a distance of 3 meters.
- (e) As shown in § 15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

8.5.2 Test summary

Verdict	Pass		
Tested by	P. Barbieri	Test date	October 3, 2022
Sample tested	4744740002 for radiated measurement and 4744740003 for conducted measurement		

8.5.3 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≥DTS bandwidth (Maximum peak conducted output power).

Spectrum analyser settings:

Resolution bandwidth	≥ 99% bandwidth
Video bandwidth	≥ 3 × RBW
Frequency span	≥ 2 × 99% bandwidth
Detector mode	Peak
Trace mode	Max-hold

8.5.4 Test equipment used

Equipment	Manufacturer	Model no.	Asset no.
Spectrum Analyzer	Rohde & Schwarz	FSW43	101767
Antenna 1 - 18 GHz	Schwarzbeck Mess-Elektronik	STLP9148	STLP 9148-152
Controller	Maturo	FCU3.0	10041
Tilt antenna mast	Maturo	TAM4.0-E	10042
Turntable	Maturo	TT4.0-ST	2.527
Semi-anechoic chamber	Nemko S.p.a.	10m semi-anechoic chamber	530

8.5.5 Test data

Table 8.5-2: Output power and EIRP results (radiated and conducted measurement)

Frequency, MHz	Field strength, dBμV/m	Field strength, dBμV/m	Field strength, dBμV/m	Field strength, dBμV/m
	Peak	Average	Limit	Margin
2457	93.5	93.0	94	-1

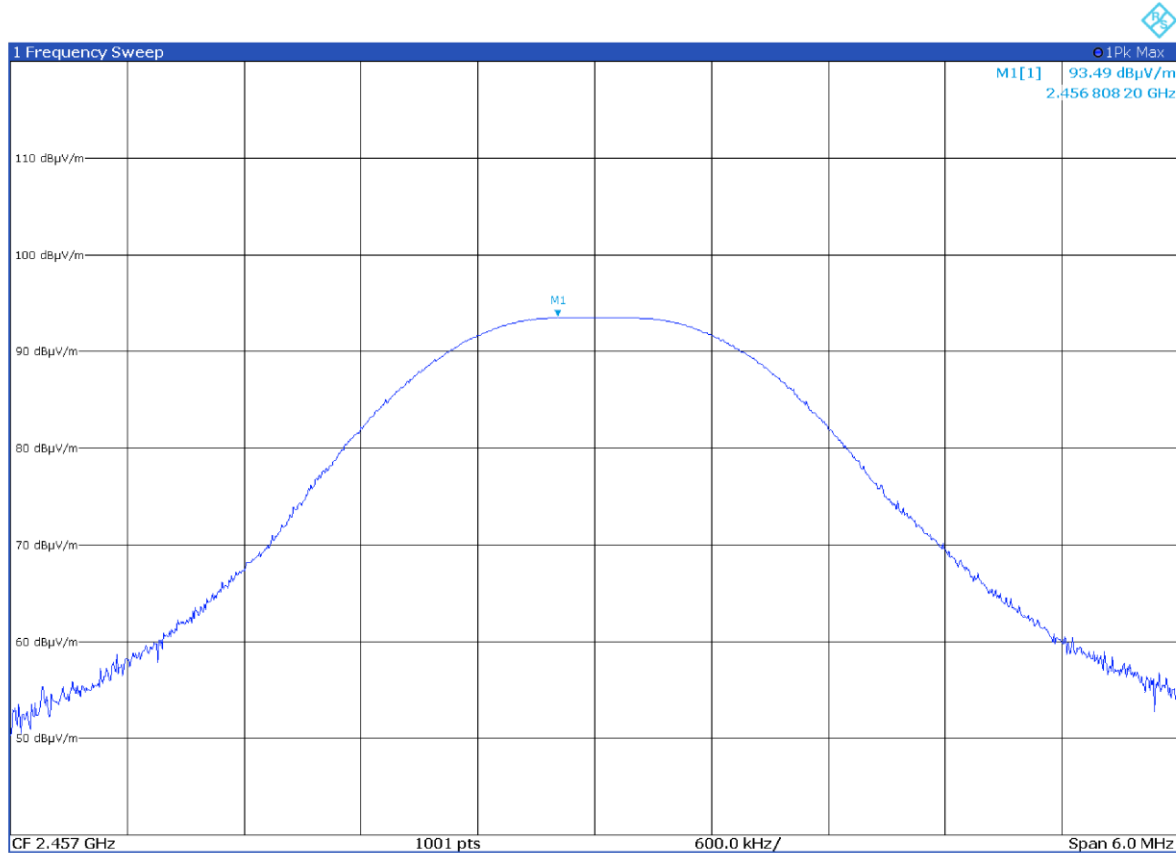


Figure 8.5-1: Field strength

8.6 Spurious (out-of-band) unwanted emissions

8.6.1 References, definitions and limits

FCC §15.249:

- (a) The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Table 8.6-1: Field strength limits

Fundamental frequencies (MHz)	Field strength of fundamental		Field strength of harmonics	
	(mV/m)	(dBμV/m)	(μV/m)	(dBμV/m)
902–928	50	94	500	54
2400–2483.5	50	94	500	54
5725–5875	50	94	500	54
24.0–24.25*	250	108	2500	68

- (c) Field strength limits are specified at a distance of 3 meters.
- (d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in § 15.209, whichever is the lesser attenuation.
- (e) As shown in § 15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

Table 8.6-2: FCC §15.209 – Radiated emission limits

Frequency, MHz	Field strength of emissions		Measurement distance, m
	μV/m	dBμV/m	
0.009–0.490	2400/F	$67.6 - 20 \times \log_{10}(F)$	300
0.490–1.705	24000/F	$87.6 - 20 \times \log_{10}(F)$	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.

Table 8.6-3: 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	P. Barbieri	Test date	September 22, 2022

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.
- EUT was set to transmit with 100 % duty cycle.
- Radiated measurements were performed at a distance of 3 m.

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:	3 MHz
Detector mode:	RMS
Trace mode:	Power average
Averaging sweeps number:	100

8.6.4 Test equipment used

Equipment	Manufacturer	Model no.	Asset no.
EMI Receiver	Rohde & Schwarz	ESW44	101620
Antenna Trilog 25MHz - 8GHz	Schwarzbeck Mess-Elektronik	VULB9162	9162-025
Antenna 1 - 18 GHz	Schwarzbeck Mess-Elektronik	STLP9148	STLP 9148-152
Double Ridge Horn Antenna	RFSpin	DRH40	061106A40
Broadband Amplifier	Schwarzbeck Mess-Elektronik	BBV9718C	00121
Broadband Bench Top Amplifier	Sage	STB-1834034030-KFKF-L1	18490-01
Controller	Maturo	FCU3.0	10041
Tilt antenna mast	Maturo	TAM4.0-E	10042
Turntable	Maturo	TT4.0-5T	2.527
Semi-anechoic chamber	Nemko S.p.a.	10m semi-anechoic chamber	530

8.6.5 Test data

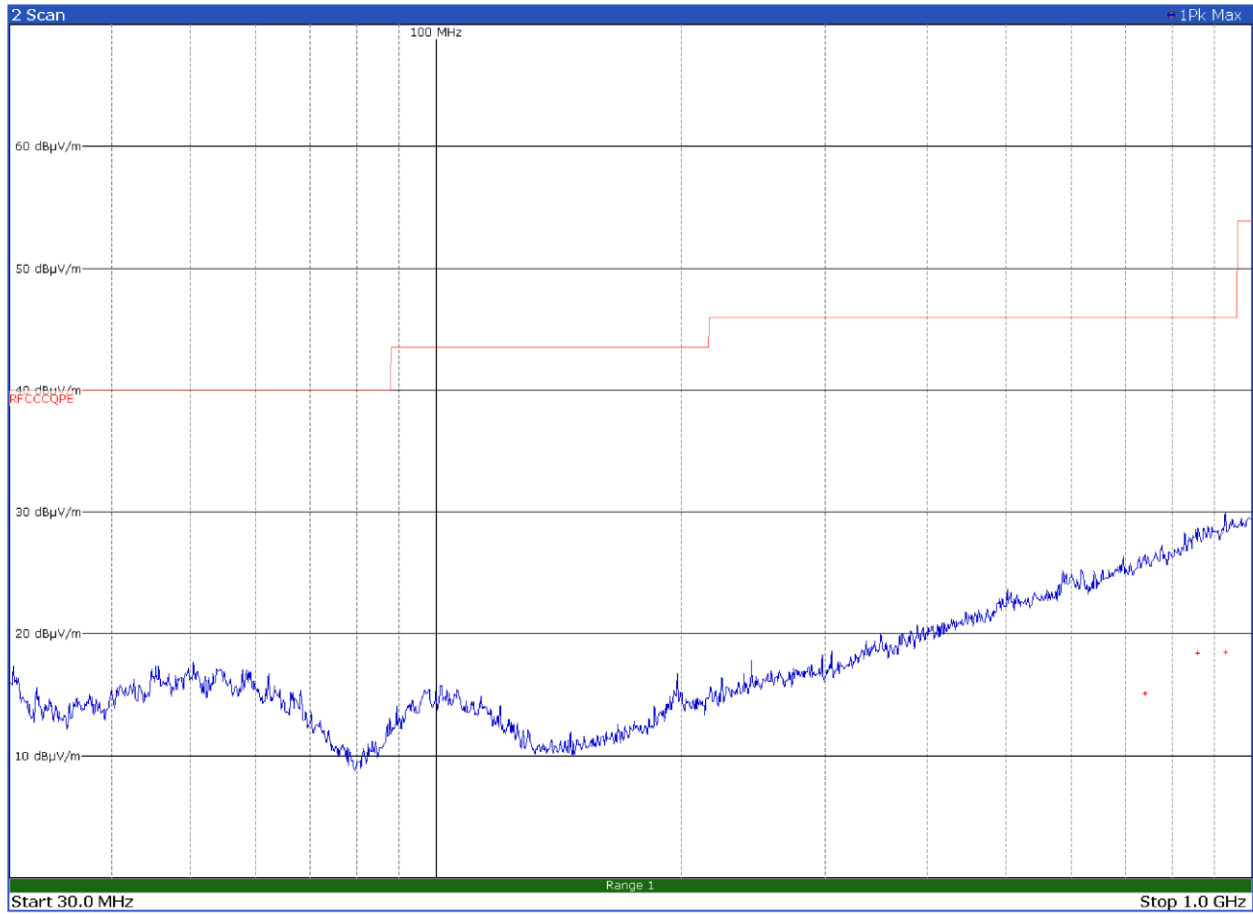


Figure 8.6-1: Radiated spurious emissions on with antenna in horizontal polarization

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
739.2300	15.2	46.0	-30.8	QP
859.0800	18.5	46.0	-27.5	QP
928.0200	18.6	46.0	-27.4	QP

Test data, continued

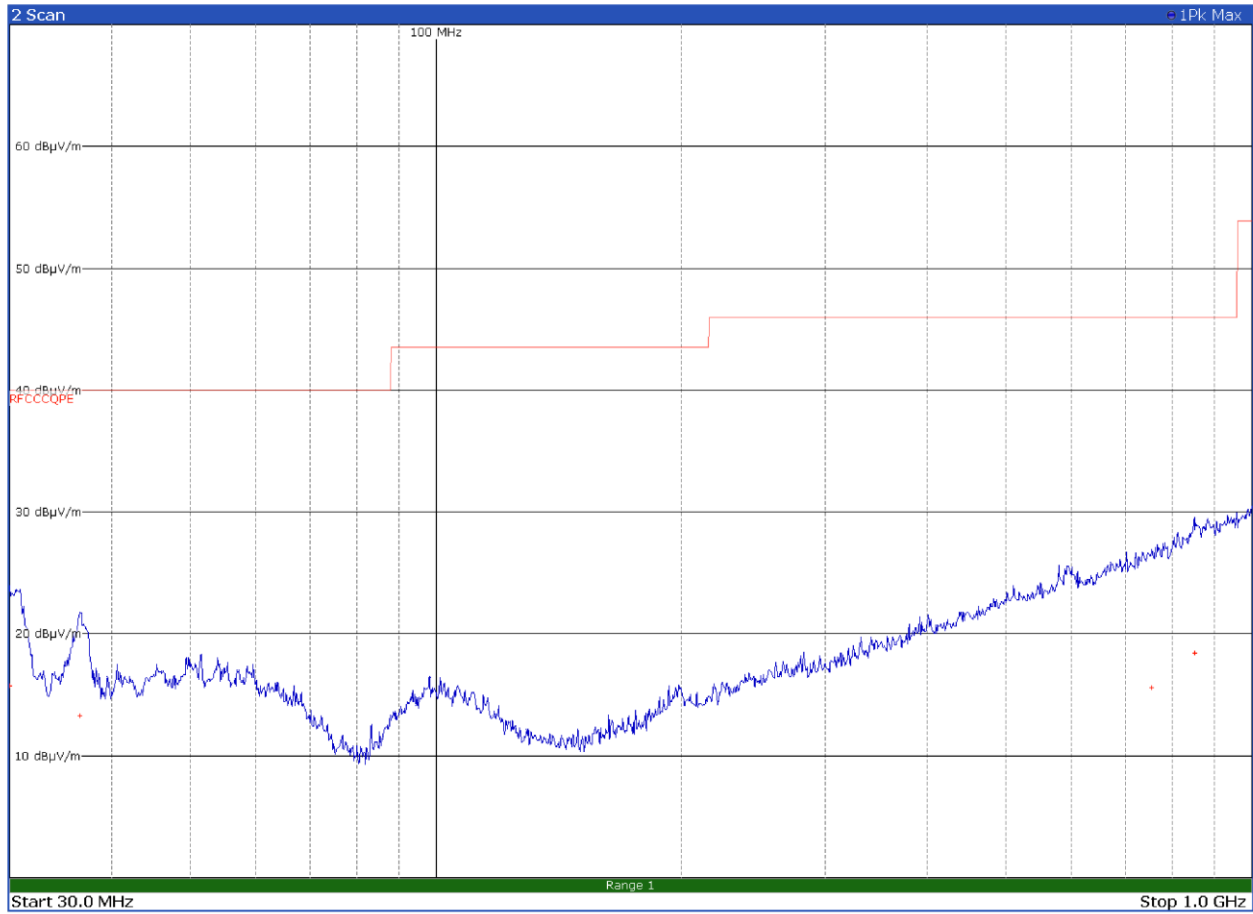


Figure 8.6-2: Radiated spurious emissions with antenna in vertical polarization

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
30.0000	15.8	40.0	-24.2	QP
36.5700	13.3	40.0	-26.7	QP
754.2900	15.6	46.0	-30.4	QP
850.4400	18.5	46.0	-27.5	QP

Test data, continued

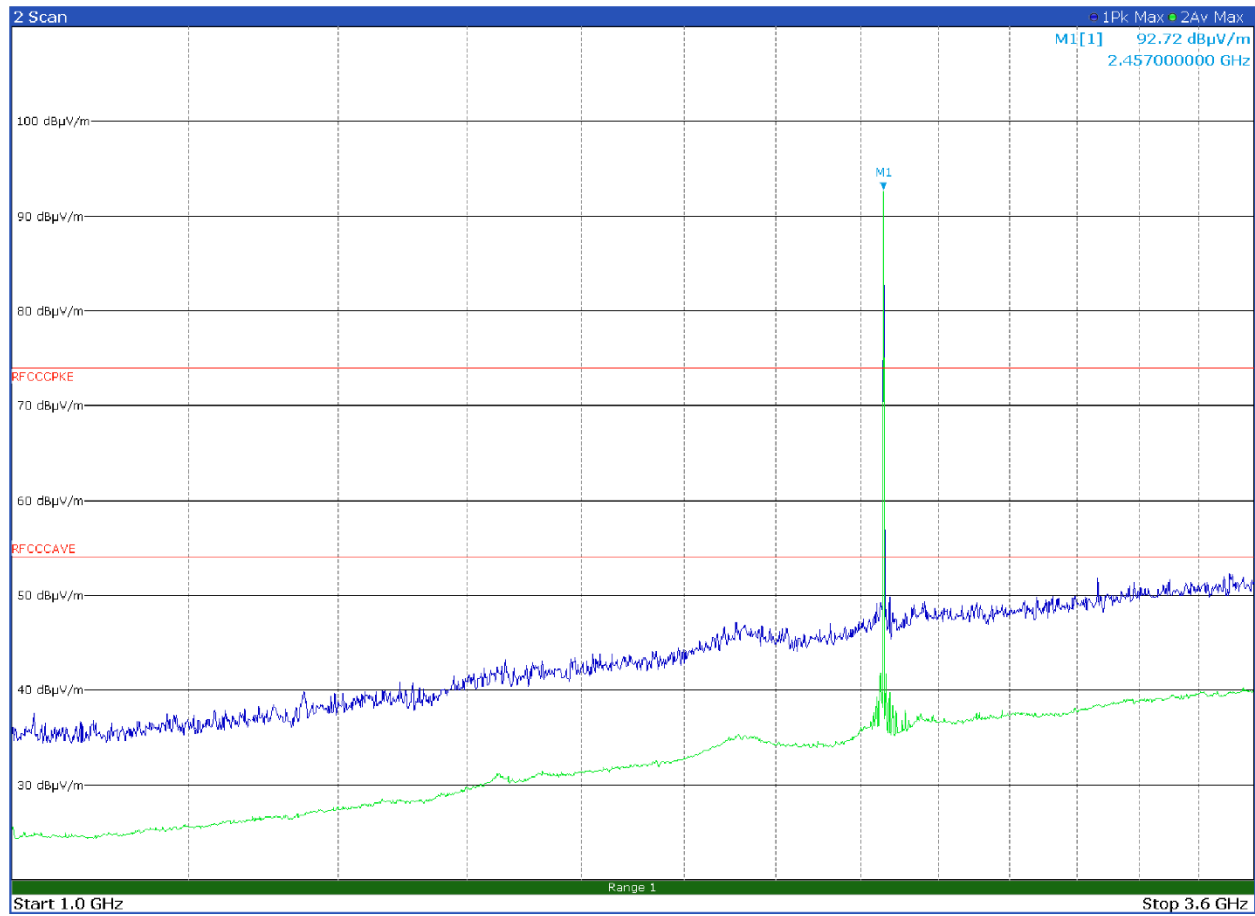


Figure 8.6-3: Radiated spurious emissions with antenna in horizontal polarization

No spurious detected in this range- Limit exceeded by the carrier

Test data, continued

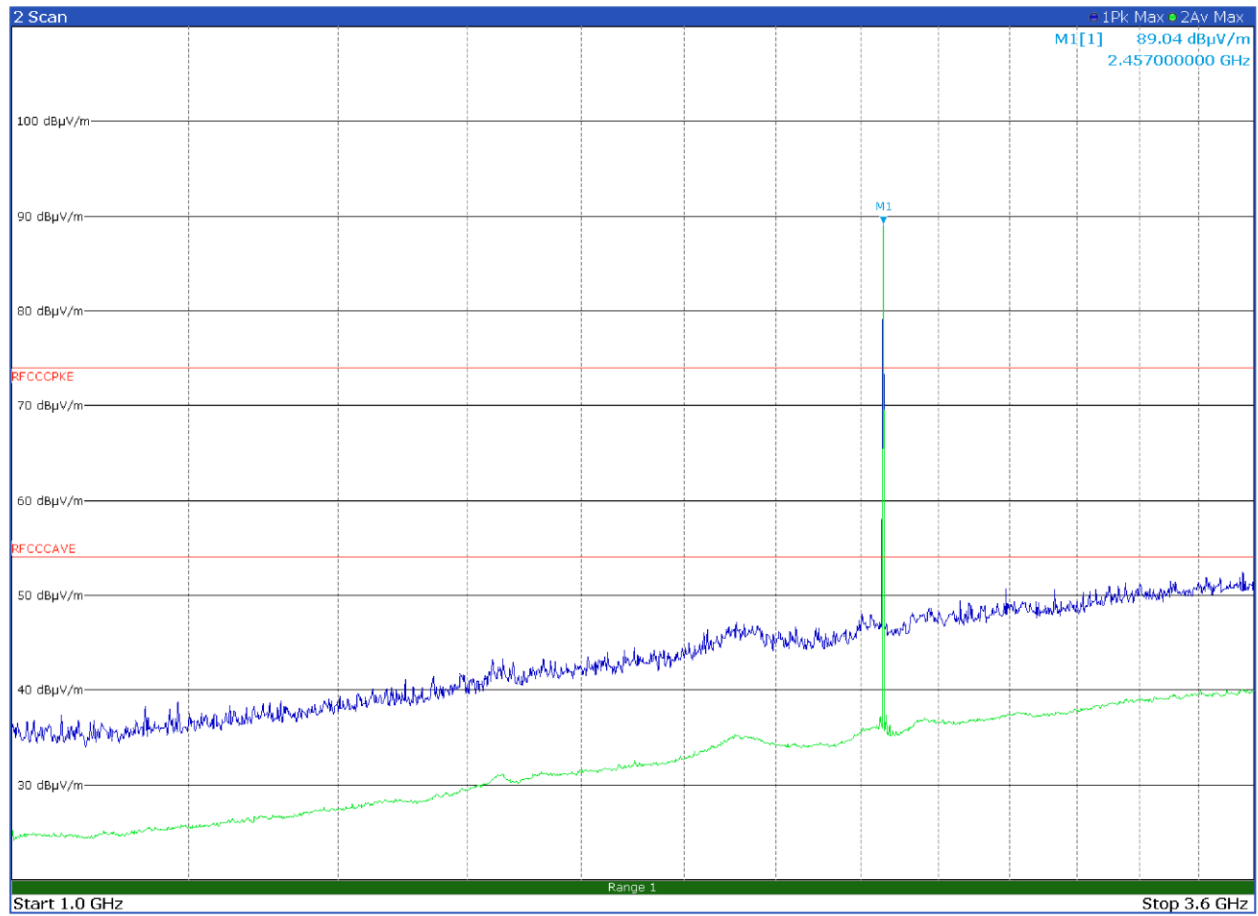


Figure 8.6-4: Radiated spurious emissions with antenna in vertical polarization

No spurious detected in this range- Limit exceeded by the carrier

Test data, continued

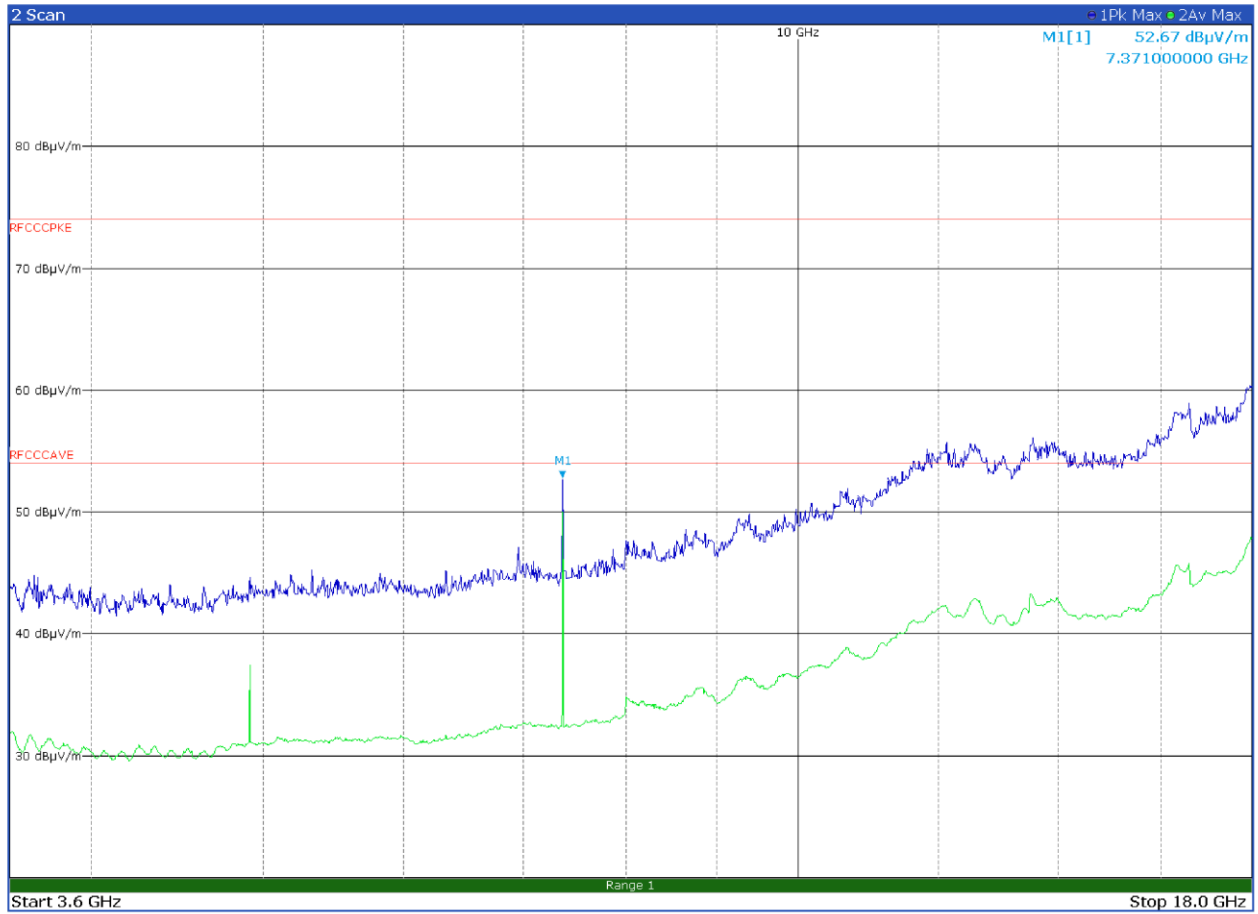


Figure 8.6-5: Radiated spurious emissions with antenna in horizontal polarization

Frequency (GHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
7.3710	52.7	74	-21.3	Pk
7.3710	52.3	54	-1.7	Av

Test data, continued

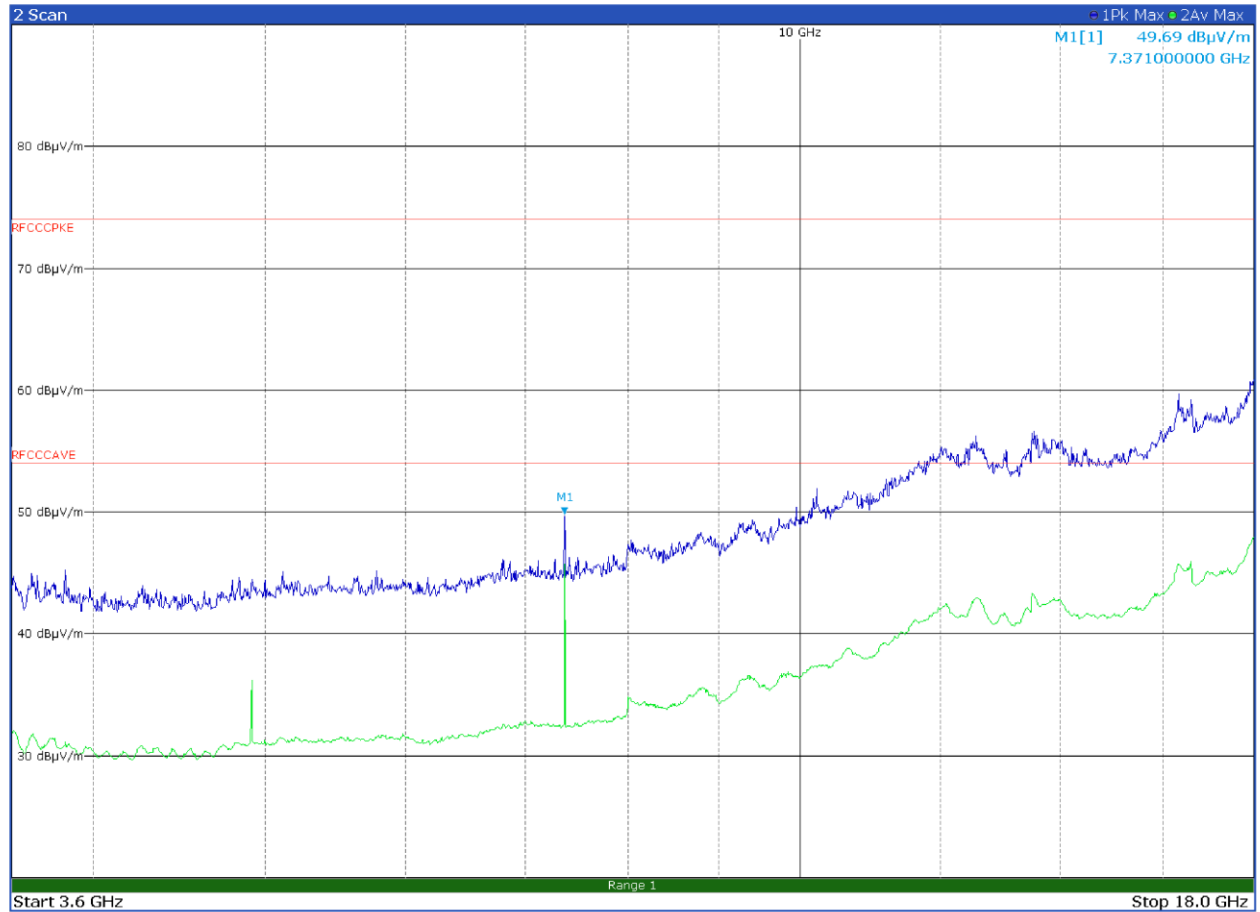


Figure 8.6-6: Radiated spurious emissions with antenna in vertical polarization

Frequency (GHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
7.3710	49.7	74	-24.3	Pk
7.3710	49.2	54	-4.8	Av

Test data, continued

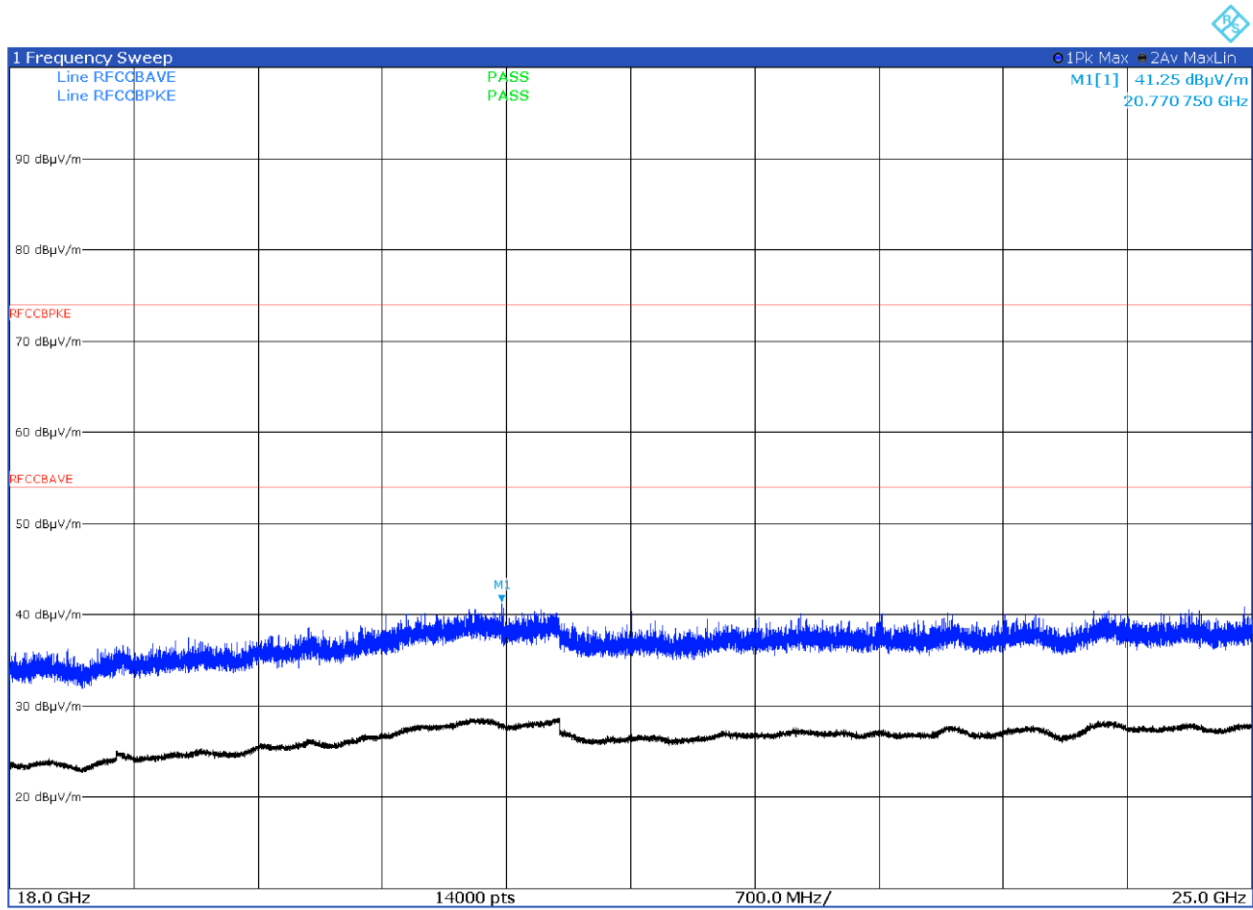


Figure 8.6-7: Radiated spurious emissions on low channel with antenna in horizontal polarization

No spurious detected in this range

Test data, continued

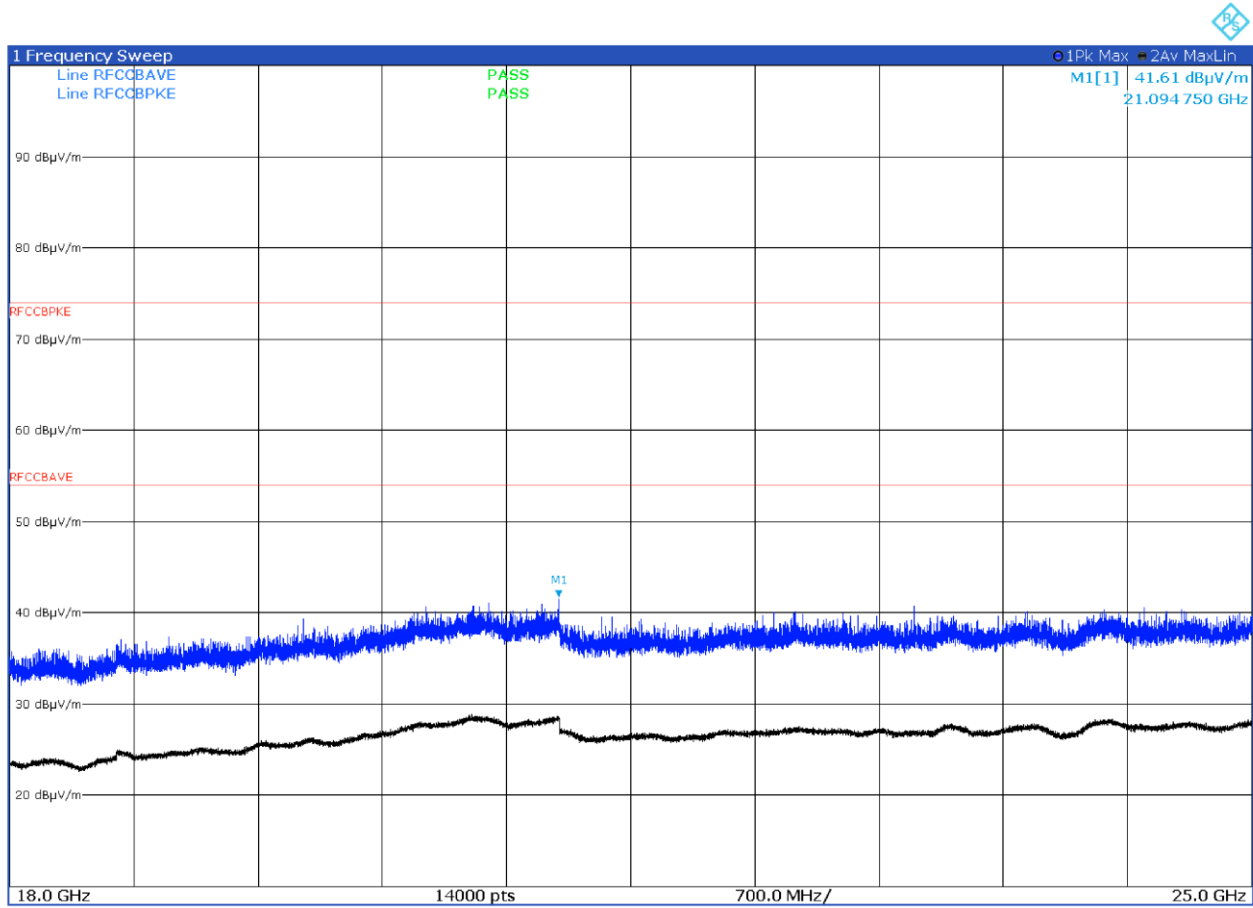


Figure 8.6-8: Radiated spurious emissions on low channel with antenna in vertical polarization

No spurious detected in this range

Section 9 EUT photos

9.1 Set-up photos



Figure 9.1-1: Radiated emissions set-up for frequencies below 1 GHz



Figure 9.1-2: Radiated emissions set-up for frequencies above 1 GHz

9.2 External photos



Figure 9.2-1: External view photo



Figure 9.2-2: External view photo

End of the test report