

Report:	Electromagnetic compatibility and Radio spectrum Matters		Report no:	20CH-00247.R01
Product name:	MODsense T		Mandate no:	20CH-00247
Serial no:	DUT-06/B, DUT-07/B DUT-10/B and DUT-11/B	Model number:	MODsense T2	
Applicant:	modum.io AG Poststrasse 5-7 8001 Zürich SWITZERLAND	Date of test:	2020-09-01 to 2020-10-21	

Standards		Result
47 CFR, Part 15	Subpart C, Intentional radiators: §§ 15.209/247	Pass
	Subpart B, Class B digital devices: § 15.109	Pass

These results were achieved without modifications of EUT

Test performed by

B. Itzcovich
EMC Test Engineer



Report prepared by

B. Itzcovich
EMC Test Engineer



Report controlled and approved by

J. Ding
EMC Test Engineer



Rossens, 2020-11-03

(Issue Date)

2015-04-10_Rev01

Main language : English

The present document results from tests on one specimen and does not prejudice to the conformity of all the manufactured products.

This report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.

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1. Summary of test results

§	Test Type	Result
6	Emission	CFR 47 Part 15 Industry Canada
6.1	Minimum 6 dB bandwidth CFR 47 § 15.247 (a)(2)	Pass
6.2	Antenna gain & effective radiated power CFR 47 § 15.247 (b)(4) RSS-247 § 5.4 (2) and (6)	Pass
6.3	Maximum output power (conducted) CFR 47 § 15.247 (b)(1) (3)	Pass
6.4	Band-edge emission (conducted) CFR 47 § 15.247 (d)	Pass
6.5	Band-edge emission (radiated) CFR 47 § 15.247 (d) CFR 47 § 15.205	Pass
6.6	Maximum power spectral density CFR 47 § 15.247 (e) and (f)	Pass
6.7	Spurious emissions – conducted (transmitter) CFR 47 § 15.247 (d)	Pass
6.8	Spurious emissions – radiated (transmitter) CFR 47 § 15.247 (d) CFR 47 § 15.209 (a) CFR 47 § 15.205	Pass
6.9	Radiated emission – receiver CFR 47 § 15.109	Pass
-	Conducted emission CFR 47 § 15.207	N/A ¹
6	Emission	CFR 47 Part 2
6.10	Designation of emission FCC 47 §2.201 FCC 47 §2.202	1M06FXD

1. Powered with 3.0 V_{DC} internal battery (LiMnO₂, not rechargeable). EUT is portable and has no cable/port

2. Applied standards

47 CFR Part 15 Subpart C	Code of Federal Regulations - Title 47 - Telecommunication, Part 15, Subpart C: "Intentional Radiators"
47 CFR Part 15 Subpart B	Code of Federal Regulations - Title 47 - Telecommunication, Part 15, Subpart B: "Unintentional Radiators"

3. Applicant

Applicant name and address	modum.io AG Poststrasse 5-7 8001 Zürich SWITZERLAND
Contact Person	Mr Andreas Gawlowski
Telephone	+41 44 586 66 15
E-mail	andreas.gawlowski@modum.io
Mandate no	20CH-00247

4. Equipment under test

4.1 Identification

Manufacturer name and address	modum.io AG Poststrasse 5-7 8001 Zürich SWITZERLAND
Production country	Sri Lanka
Brand name	MODsense
Product name	MODsense T
Product description	Wireless temperature recorder for transport and storage of sensitive goods
Model number	MODsense T2
Serial no	DUT-06/B, DUT-07/B DUT-10/B and DUT-11/B
FCC ID	2AU2P-T202011
Software version	RF test firmware
Lowest Frequency	32.768 kHz (RTC clock) 100 kHz (I2C clock)
Highest frequency	32 MHz (uC Xtal) / 2.48 GHz (RF Transmitter carrier)
Supply	U = 3.0 V _{DC} (LiMnO ₂ internal battery) / I _{max} 15 mA
Dimension	~4 cm x ~1 cm x ~9.5 cm (l x w x h)
Technical	None. The equipment is completely identified by the above-mentioned information. modum.io AG assures the traceability of the documentation and is responsible for the product identification.

4.2 Pictures of the EUT



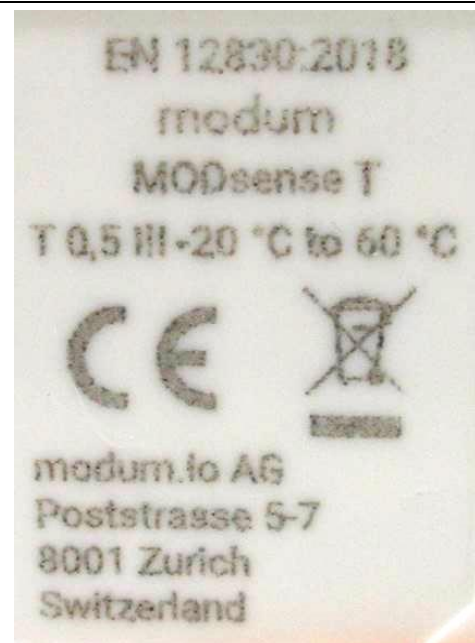
EUT (front view)



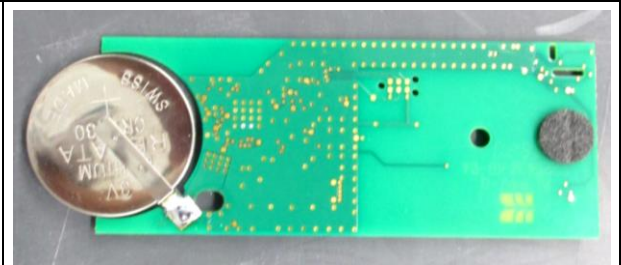
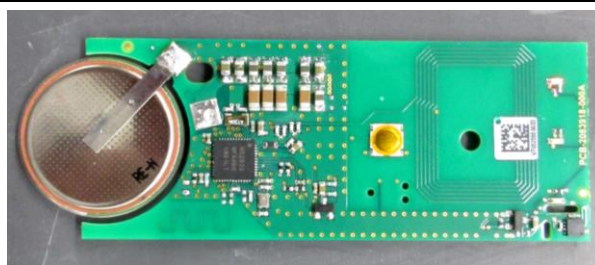
EUT (rear view with marking example)

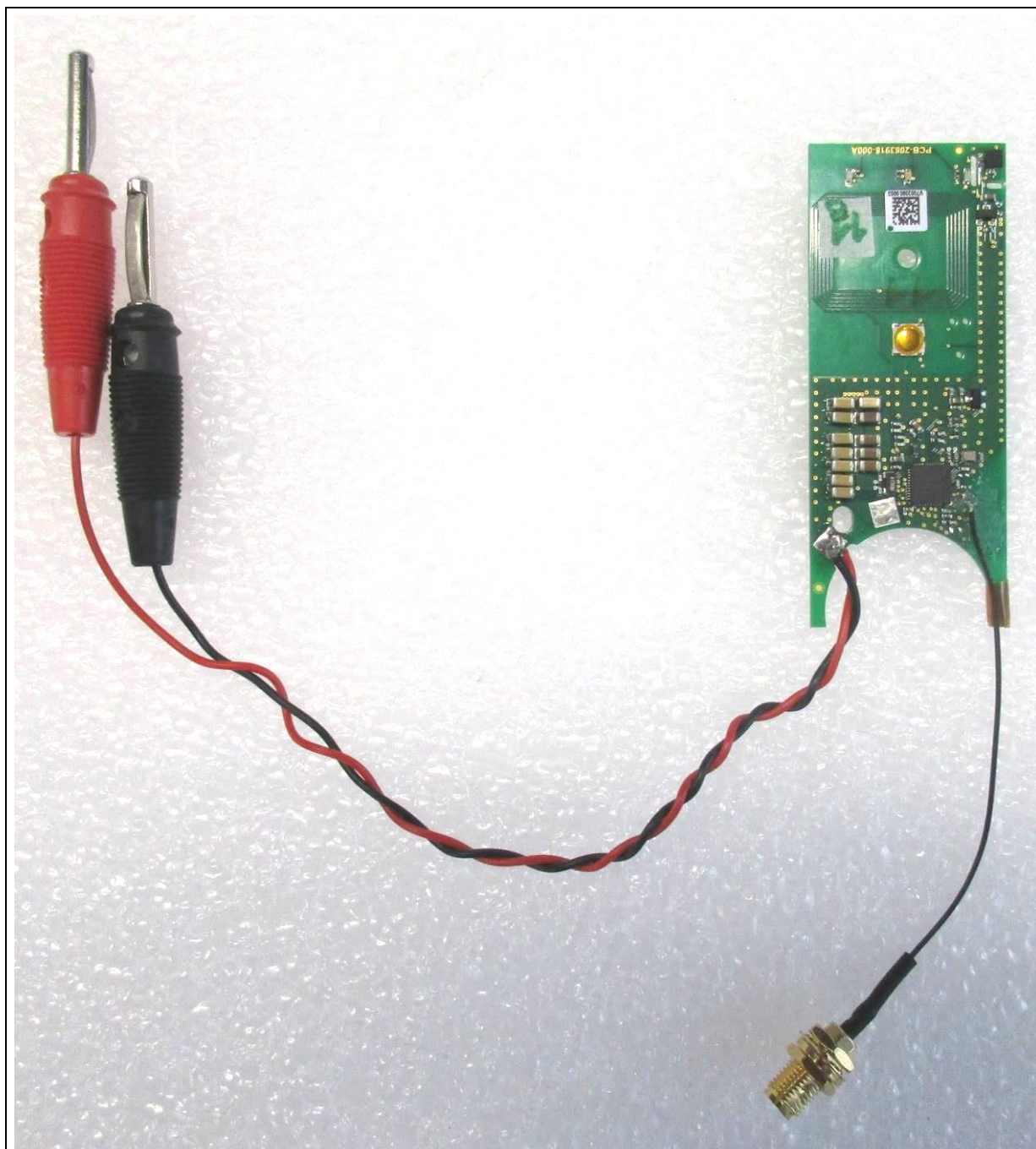


EUT (inside view)



Marking example (on bottom)





Electronic board with temporary antenna and power connectors

4.3 Classification

CFR 47 Part 15	☒ Unintentional radiator (Subpart B), Receive mode ☐ Class A digital device ☒ Class B digital device ☒ The highest frequency of the internal sources of the EUT is less than 108 MHz (measurement shall be made up to 1 GHz). ☐ The highest frequency of the internal sources of the EUT is between 108 MHz and 500 MHz (measurement shall be made up to 2 GHz). ☐ The highest frequency of the internal sources of the EUT is between 500 MHz and 1 GHz (measurement shall be made up to 5 GHz). ☐ The highest frequency of the internal sources of the EUT is above 1 GHz (measurement shall be made up to 5 times the highest frequency or 40 GHz, whichever is lower). ☒ Intentional radiator (Subpart C), Transmit mode ☐ frequency hopping intentional radiator ☒ digitally modulated intentional radiator ☐ hybrid system that employs a combination of both frequency hopping and digital modulation techniques ☐ other type of intentional radiator: ☒ The highest fundamental frequency of the EUT is less than 10 GHz (measurement shall be made up to the tenth harmonic or 40 GHz, whichever is lower). ☐ The highest fundamental frequency of the EUT is between 10 GHz and 30 GHz (measurement shall be made up to the fifth harmonic or 100 GHz, whichever is lower). ☐ The highest fundamental frequency of the EUT is above 30 GHz (measurement shall be made up to the fifth harmonic or 200 GHz, whichever is lower).
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4.4 Transmitter characteristics (according to modum.io AG)

RF technology	BLE transceiver based on Nordic nRF52832 SoC
Method of frequency generation	☒ Crystal ☐ Synthesizer ☐
Transmitter operating frequency range (OFR) The OFR is the total range of frequencies covered by one type, or by a family of equipment. It is noted that a family of equipment may be capable of covering a wider frequency range than the alignment frequency range of one type of equipment.	2.402 GHz to 2.480 GHz.
Channel separation (if applicable)	2 MHz
Number of channels (if applicable)	40
Maximum rated output power	2.43 dBm (at transmitter RF output connector)
Variable carrier output	☒ Transmitter carrier output is not variable. RF output: $P_{OUT} = 1.75 \text{ mW}$ ☐ Transmitter carrier output is variable. Max. RF output: $P_{OUT \text{ MAX}} =$ Min. RF output: $P_{OUT \text{ MIN}} =$ ☐ RF output continuously variable ☐ RF output stepped: dB per step
Modulation	☐ Amplitude ☐ Frequency: Deviation kHz ☐ Phase ☐ Pulse Pulse repetition frequency Duty cycle ☒ Other DTS, GFSK (Bluetooth Low Energy)
	☒ Transmitter can be operated without modulation (only for EMC tests) ☐ Transmitter can only be operated with modulation

4.5 Receiver characteristics (according to modum.io AG)

Receiver operating frequency range	2.402 GHz to 2.480 GHz
Channel separation (if applicable)	2 MHz
Number of channels (if applicable)	40

4.6 Ports

Port	Cable			Remark
	Max. length	Type	Screen	
None	---	---	---	---

5. Test conditions

5.1 Climatic conditions, location and date

Location	Date	Temp.	Pressure [QFE]	Rel. humidity
Eurofins Electric & Electronic Product Testing AG 1728 Rossens SWITZERLAND	2020-09-01 to 2020-10-21	See § 6		

5.2 Test facility and methodology

The test site is accepted by FCC:
 - Test Firm Registration Number: 683197
 - Designation Number: CH5001

Conducted and radiated measurements are performed according to the ANSI C63.4-2014 and C63.10-2013 procedures.

5.3 Attendant persons

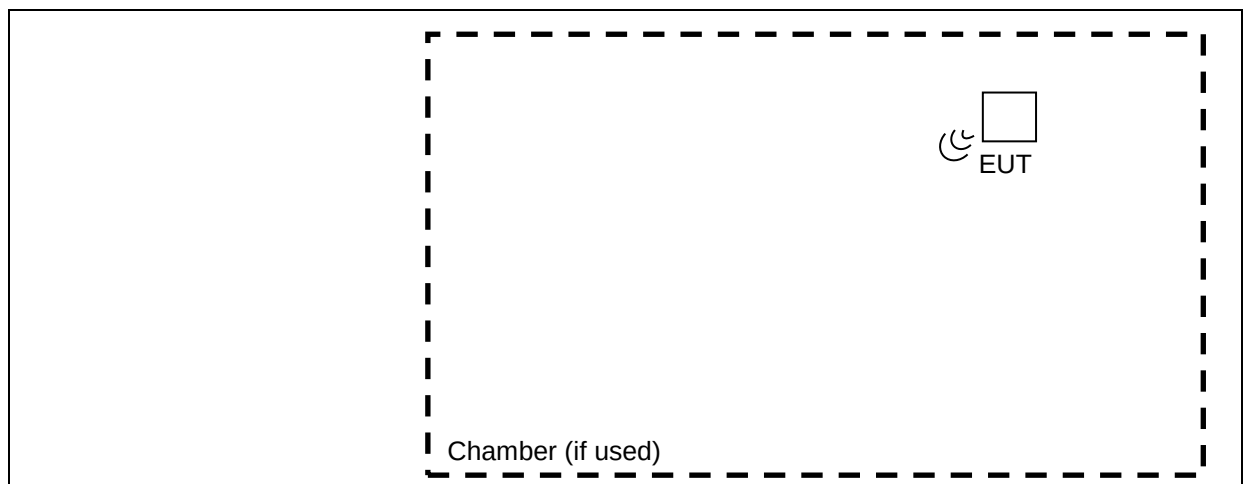
Test Engineer(s):

B. Itzcovich
 EMC Test Engineer

Other(s):

Name	Company
Mr Thomas Mühlemann	modum.io AG

5.4 Test configuration



5.5 Operating conditions

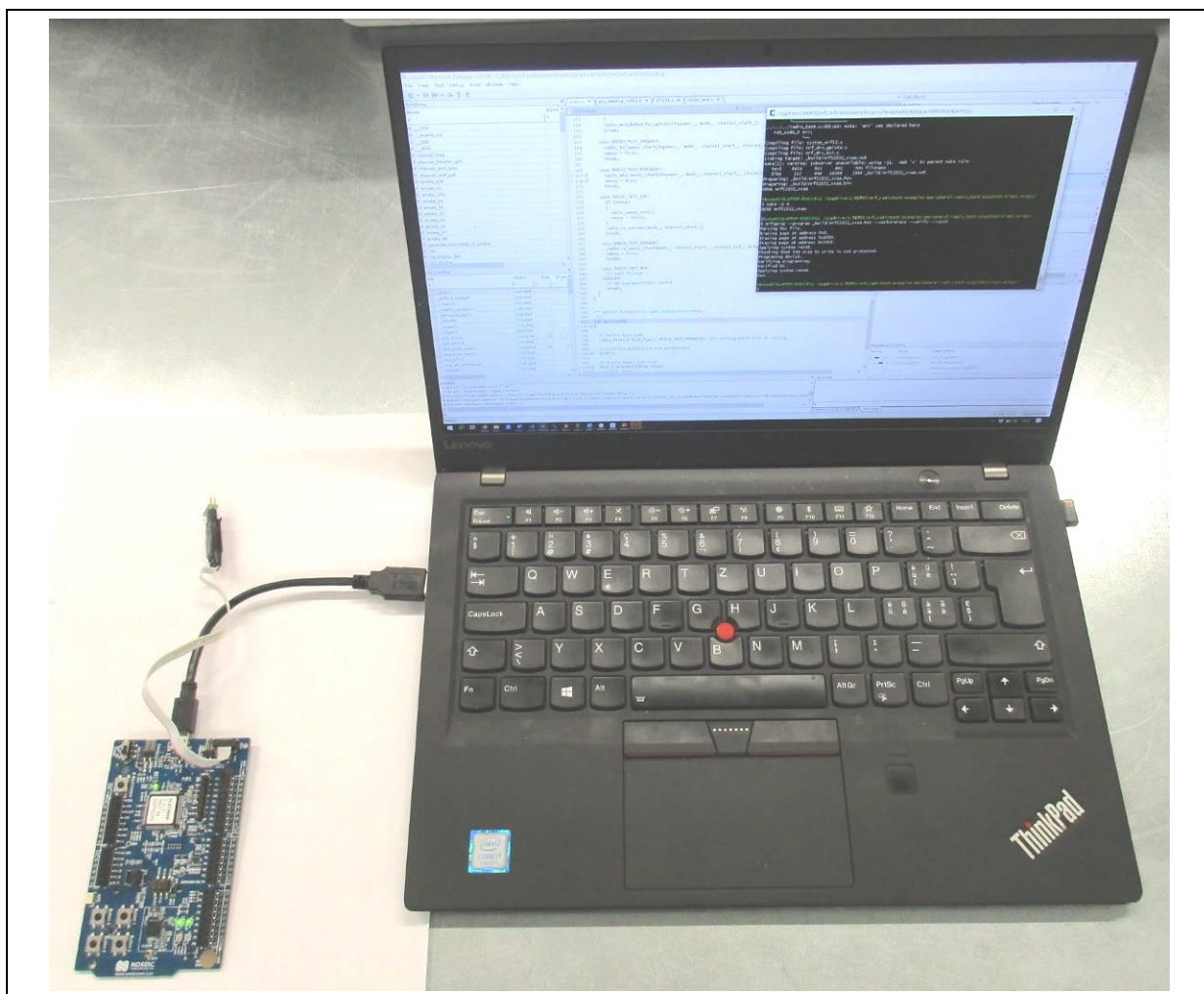
Power supply during tests if not stated otherwise in §6 : 3 V_{DC} (internal battery). Special modes for EMC testing:

- Continuous hopping transmission of random data on three frequencies (2.40, 2.44, 2.48 GHz)
- Continuous hopping transmission of random data on single frequency (2.40 or 2.44 or 2.48 GHz)
- Continuous reception on single frequency (2.440 GHz)

5.6 Auxiliary equipment

The following equipment is used for the monitoring of the EUT or is necessary for the EUT but is not part of the EUT

Product	Brand	Model No.	ID	Remark
Laptop	Lenovo	ThinkPad X1 Carbon	- - -	To change EUT parameters with Debug interface
Debug interface	Nordic	nRF52 DK	- - -	To change EUT parameters with Laptop



6. Test results

6.1 Minimum 6 dB bandwidth

Introduction: Channel-bandwidth measured at -6 dBc.

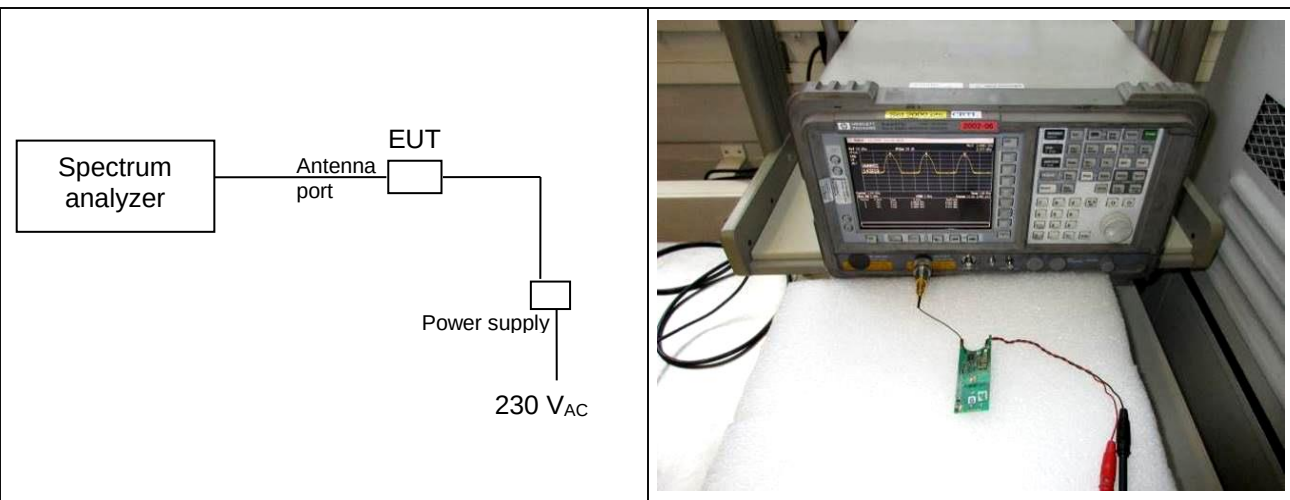
Test site: ☐ SAC3 ☐ open test site
☐ SAC10 ☒ laboratory

Meas. uncertainty: 9kHz – 3GHz: ± 1 dB
 3GHz – 6.7GHz: ± 2.1 dB
 6.7GHz – 13.2GHz: ± 2.6 dB
 13.2GHz – 19GHz: ± 2.8 dB
 19GHz – 26.5GHz: ± 3 dB

Method: Measurement of the conducted power on the antenna connector or a test fixture, according to KDB 558074 §8.2

Limit: For systems using digital modulation techniques, the minimum 6 dB bandwidth shall be at least 500 kHz.

Test set-up:



Remarks: - - -

Test equipment:

Spectrum analyzer	☐ 88-14	☐ 94-24	☒ 02-06	☐ 03-45	☐ 05-39	☐ 07-53
Power supply	☐ 99-07	☐ 04-31				
Cables	☐ 11-13					

Result: ☒ pass ☐ fail ☐ not applicable ☐ not tested

Results of the test

Applicant: modum.io AG

Apparatus: MODsense T, DUT-11/B

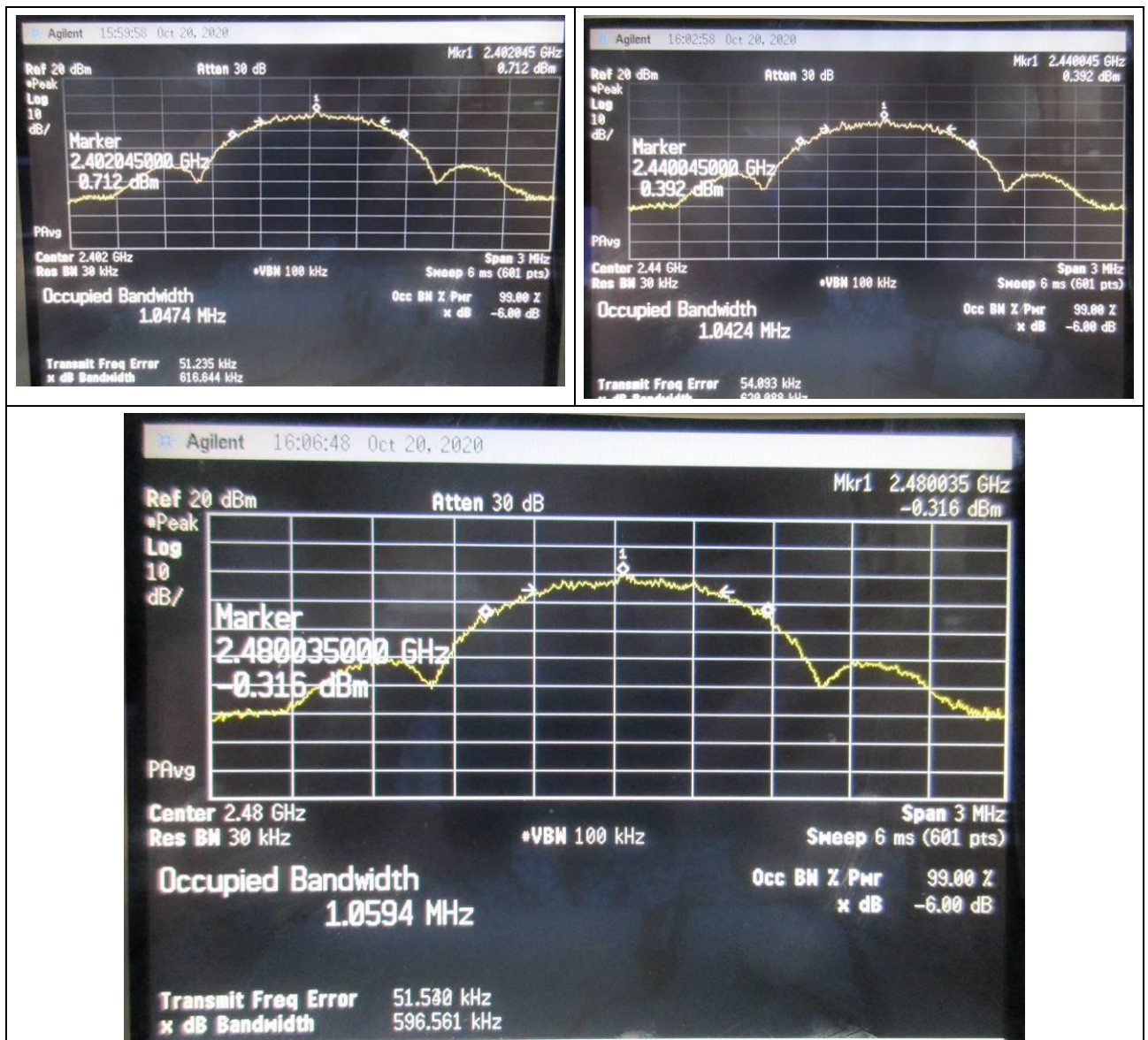
Operating mode: TX (f = 2.402 / 2.440 / 2.480 GHz), modulated, Pmax (4 dBm)

Remarks: Measured on temporary antenna connector

Modifications: ☒ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Climatic conditions: Temperature: 22 – 25 °C Humidity: 35 – 50 % Pressure QFE: 930 – 940 hPa

frequency [GHz]	6 dB bandwidth [kHz]	Remarks
2.402	616.6	---
2.440	620.1	---
2.480	596.6	Minimum 6 dB bandwidth

Place and date of test:
Operator:Rossens, 2020-10-20
B. Itzcovich

6.2 Antenna gain & effective isotropic radiated power

Introduction: The effective radiated power is the power radiated by the antenna of an interrogator in its direction of maximum gain under specified conditions of measurement.

Test site: ☐ SAC10 ☒ SAC3

Distance: ☐ 1 m ☒ 3 m ☐ 10 m ☐ 30 m

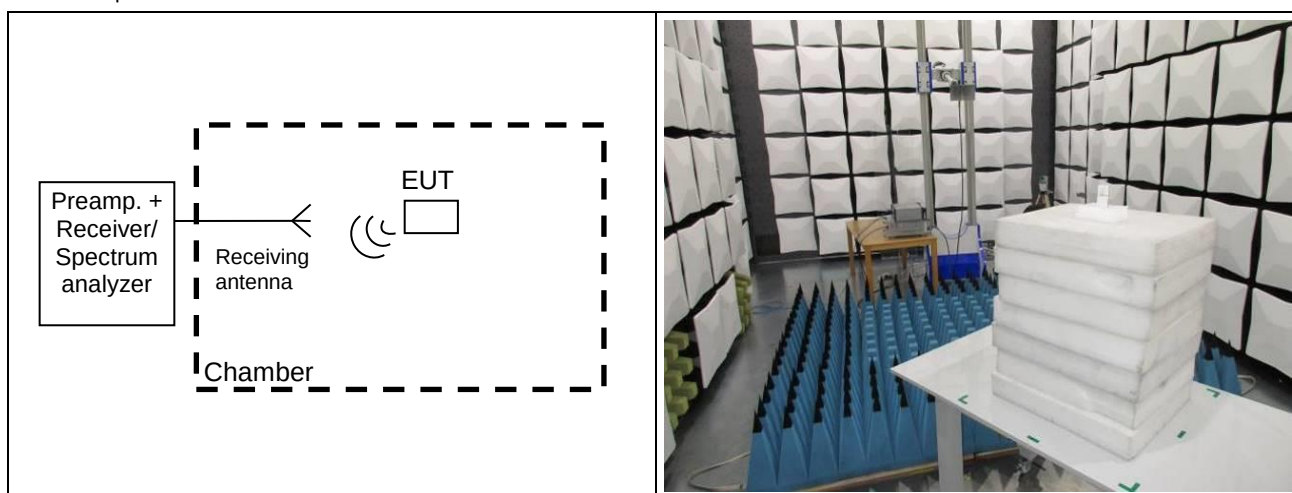
Position of EUT: 1.5 m (height of the equipment under test above floor)

Meas. uncertainty: ± 1.3 dB ($f < 300$ MHz) / ± 1.6 dB ($f > 300$ MHz)

Test method: The electromagnetic disturbance radiated by the equipment is measured using a spectrum analyzer and a wide band antenna. The antenna is moved from 1 to 4 m in height successively with horizontal and vertical polarizations, and aimed at the source by tilting. The turning table is operated through 360° during the measurements. The ERP / EIRP values are determined replacing the EUT by a substitution antenna (dipole or other).

Limit: Antenna gain 6 dBi (for a maximum conducted power 1 Watt = 30 dBm for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands). If antennas with directional gains exceeding 6 dBi are used, the maximum peak output power shall be reduced as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Test set-up:



Remarks: Measurement with EUT in position showing maximum emission at 2.44 GHz

Test equipment:

Spectrum analyzer	☐ 88-14	☐ 94-24	☐ 02-06	☐ 03-45	☐ 05-39	☒ 16-03
Receiver	☐ 85-04	☐ 90-43	☐ 94-35	☐ 04-29		
Preamplifier	☐ 11-29	☐ 95-86	☐ 05-56	☐ 05-59	☐ 05-62	☐ 05-87
Antenna (horn)	☐ 90-24	☐ 98-12	☐ 98-13	☒ 07-31		
HF-wattmeter	☐ 95-97	☐ 01-15	☐ 01-17	☐ 03-07	☒ 05-73	☐ 05-20
Thermocouple detector	☒ 09-04	☐ 05-74	☐ 05-88	☐ 07-03	☐ 10-27	☐ 03-14
Substitution antenna	☐ 89-01	☒ 00-52				
Oscilloscope	☐ 90-14	☐ 93-85	☐ 93-86	☐ 01-20	☐ 04-06	☐ 04-50
Multimeter	☐ 03-22	☐ 04-47	☐ 04-104	☐ 04-105	☐ 06-51	☐ 06-52
Frequency generator	☒ 13-16	☐ 00-42	☐ 03-39	☐ 07-02	☐ 04-89	☐ 05-78
Cables	☒ SAC3_RE_1.0/2.0/3.0		☒ 10-51	☐ SMK		
Attenuator 10dB	☐ 11-36					

Result: ☒ pass ☐ fail ☐ not applicable ☐ not tested

Results of the test

Applicant: modum.io AG

Apparatus: MODsense T, DUT-06/B and DUT-11/B

Operating mode: TX (f = 2.402 / 2.440 / 2.480 GHz), modulated, Pmax (4 dBm)

Remarks: RBW = 5 MHz; Span = 140 MHz; ST = 1.4 ms (MaxHold); RefLev = 87 dBμV
Detector = Peak; N points = 1401Modifications: ☒ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Climatic conditions: Temperature: 22 - 25 °C Humidity: 40 – 50 % Pressure QFE: 930 – 940 hPa

f [GHz]	Measurement with EUT		Power at substitution ant.		Meas. with subst. ant.	Parameters of substitution ant.		Result			Polarisation
	U [dBuV]	preamp [dB]	P [dBm]	factor [dB]	U [dBuV]	gain [dB]	att. Cable [dB]	corr. [dB]	P EIRP [dBm]	P EIRP [W]	
2.402	67.3	0.0	0.0	0	64.7	2.15	0	-62.57	4.72	2.96 mW	Vertical
2.402	56.7	0.0	0.0	0	66.2	2.15	0	-64.01	-7.36	183.65 uW	Horizontal
2.440	67.5	0.0	0.0	0	65.3	2.15	0	-63.13	4.33	2.71 mW	Vertical
2.440	57.4	0.0	0.0	0	66.1	2.15	0	-63.98	-6.57	220.29 uW	Horizontal
2.480	66.4	0.0	0.0	0	65.7	2.15	0	-63.54	2.87	1.94 mW	Vertical
2.480	50.2	0.0	0.0	0	65.0	2.15	0	-62.88	-12.66	54.20 uW	Horizontal

The antenna gain is the difference (in dB) of the radiated EIRP power and the conducted power of § 6.3 :

frequency [GHz]	Conducted power [dBm]	Radiated power EIRP [dBm]	Antenna gain [dBi]	Remarks
2.402	2.43	4.72	2.29	---
2.440	2.30	4.33	2.03	---
2.480	2.29	2.87	0.58	---

Maximum Antenna Gain = 2.3 dBi (< 6 dBi)**Maximum e.i.r.p. = 3.0 mW**Place and date of test:
Operator:Rossens, 2020-09-02 and 2020-10-20
B. Itzcovich

6.3 Maximum output power (conducted)

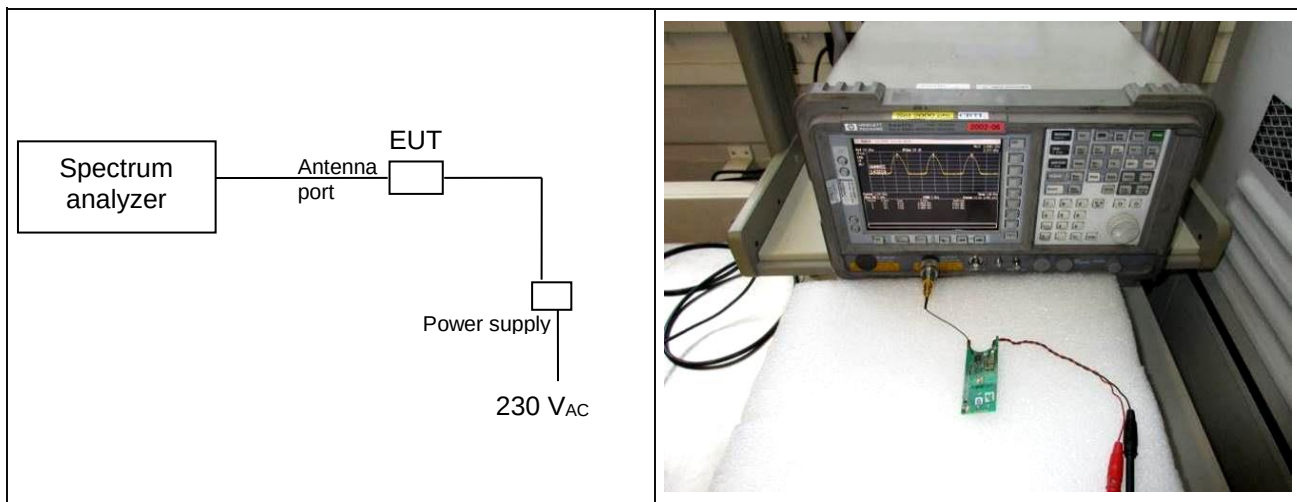
Test site: ☐ SAC3 ☐ open test site
☐ SAC10 ☒ laboratory

Meas. uncertainty: 9kHz – 3GHz: ± 1 dB
 3GHz – 6.7GHz: ± 2.1 dB
 6.7GHz – 13.2GHz: ± 2.6 dB
 13.2GHz – 19GHz: ± 2.8 dB
 19GHz – 26.5GHz: ± 3 dB

Test method: Measurement of the conducted power on the antenna connector or a test fixture.

Limit: Maximum 1 Watt (=30 dBm) for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands using antennas with directional gains that do not exceed 6 dBi. If antennas with directional gains exceeding 6 dBi are used, the maximum peak output power shall be reduced as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Test set-up:



Remarks: - - -

Test equipment:

Spectrum analyzer	☐ 88-14	☐ 94-24	☒ 02-06	☐ 03-45	☐ 05-39	☐ 07-53
Power supply	☒ 99-07	☐ 04-31				
Multimeter	☒ 09-11					
Cables	☐ 11-13					

Result: ☒ pass ☐ fail ☐ not applicable ☐ not tested

Results of the test

Applicant: modum.io AG

Apparatus: MODsense T, DUT-11/B

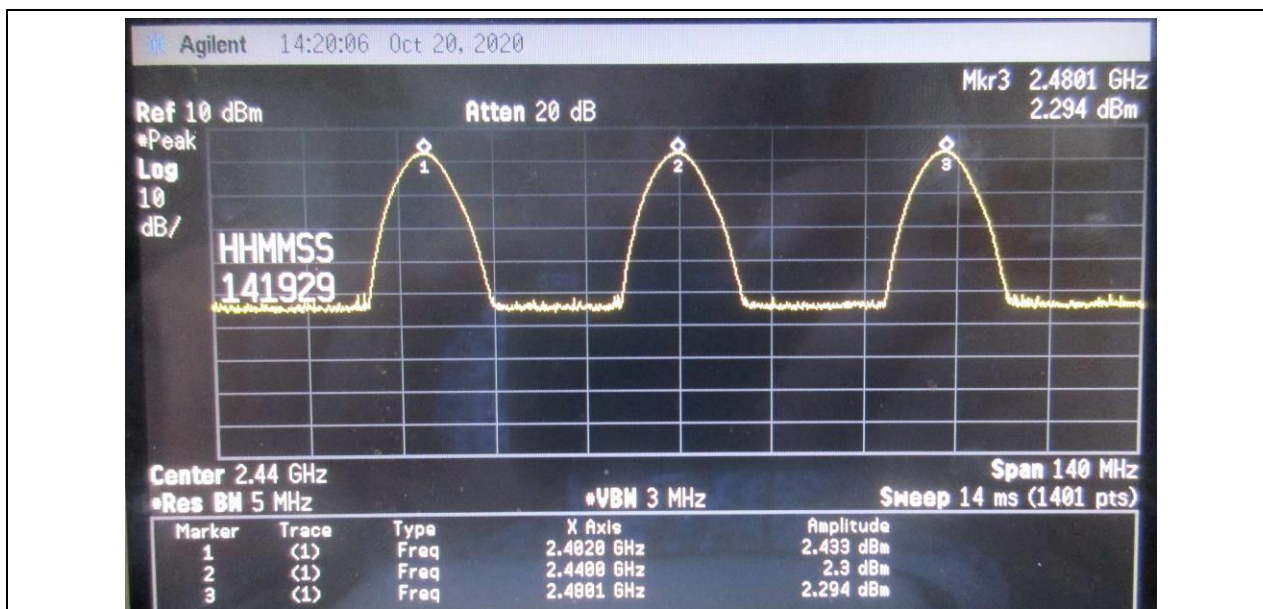
Operating mode: TX (f = 2.402 / 2.440 / 2.480 GHz), modulated, Pmax (4 dBm)

Remarks: Measured on temporary antenna connector

Modifications: ☒ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Climatic conditions: Temperature: 22 – 25 °C Humidity: 35 – 50 % Pressure QFE: 930 – 940 hPa

f normal [GHz]	Temp [°C]	U [V]	P [dBm]	Limit [dBm]	Remarks	Pass	
						Yes	No
2.402	24	3.0	2.43	30	Maximum conducted emission	☒	☐
2.440	24	3.0	2.30	30	---	☒	☐
2.480	24	3.0	2.29	30	---	☒	☐

Place and date of test:
Operator:Rossens, 2020-10-20
B. Itzcovich

6.4 Band-edge emission (conducted)

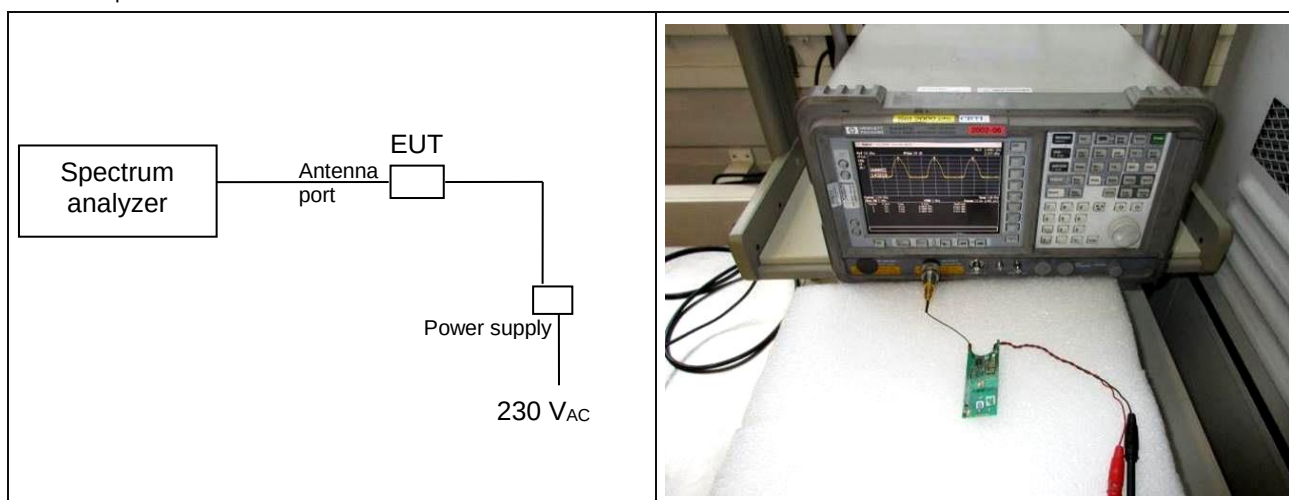
Test site: ☐ SAC3 ☐ open test site
☐ SAC10 ☒ laboratory

Meas. uncertainty: 9kHz – 3GHz: ± 1 dB
 3GHz – 6.7GHz: ± 2.1 dB
 6.7GHz – 13.2GHz: ± 2.6 dB
 13.2GHz – 19GHz: ± 2.8 dB
 19GHz – 26.5GHz: ± 3 dB

Test method: Measurement of the conducted power on the antenna connector or a test fixture.

Limit: In any 100 kHz bandwidth outside the frequency band in which the intentional radiator is operating, the radio frequency power 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.

Test set-up:



Remarks: - - -

Test equipment:

Spectrum analyzer	☐ 88-14	☐ 94-24	☒ 02-06	☐ 03-45	☐ 05-39	☐ 07-53
Power supply	☒ 99-07	☐ 04-31				
Multimeter	☒ 09-11					
Cables	☐ 11-13					

Result: ☒ pass ☐ fail ☐ not applicable ☐ not tested

Results of the test

Applicant: modum.io AG

Apparatus: MODsense T, DUT-11/B

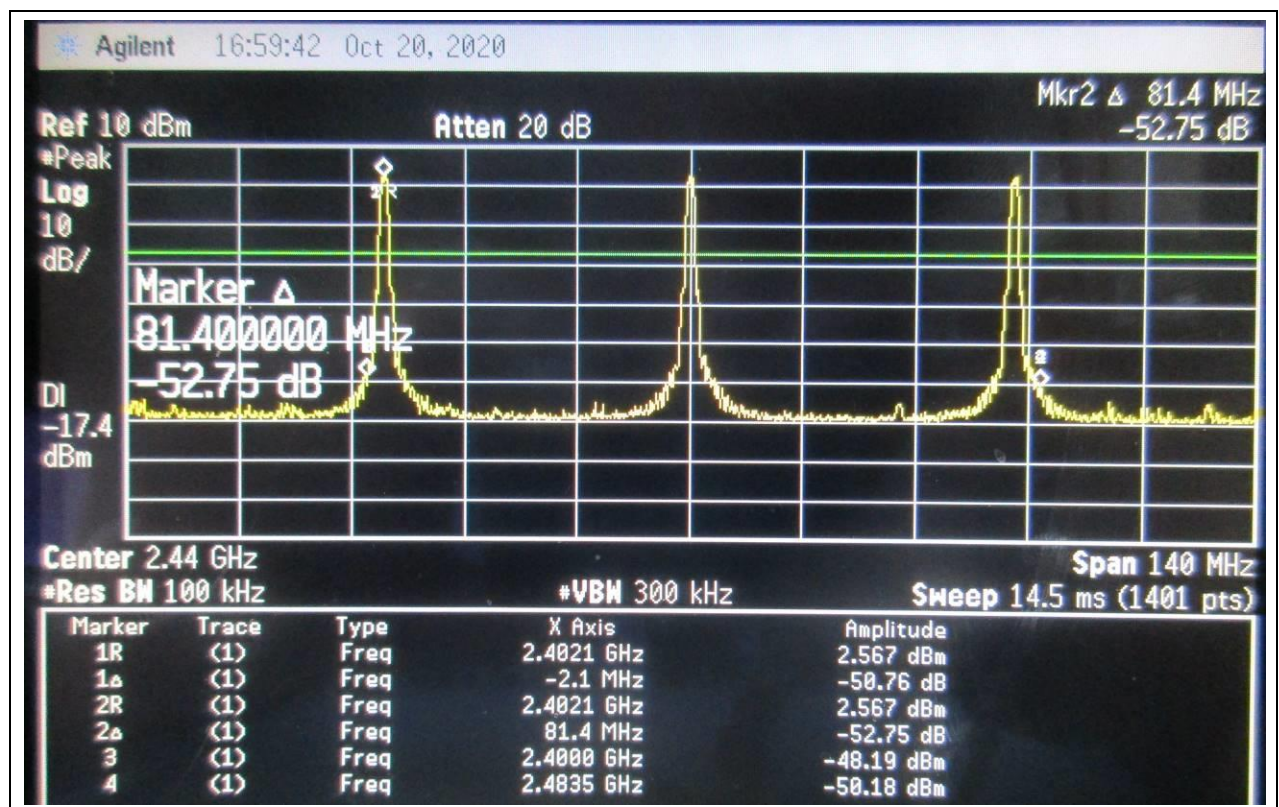
Operating mode: TX (f = 2.402 / 2.440 / 2.480 GHz), modulated, Pmax (4 dBm)

Remarks: Measured on temporary antenna connector

Modifications: ☒ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Climatic conditions: Temperature: 22 – 25 °C Humidity: 35 – 50 % Pressure QFE: 930 – 940 hPa

	Measured RF power [dBm]		Highest level [dBm]	Limit [dBm]	Margin [dB]		Pass	
	≤2400.0 MHz	≥2483.5 MHz			≤2400.0 MHz	≥2483.5 MHz	Yes	No
PK detector (RBW 100 kHz)	-48.19	-50.18	2.57	-17.43	30.76	32.75	☒	☐

Place and date of test:
Operator:Rossens, 2020-10-20
B. Itzcovich

6.5 Band-edge emission (radiated)

Test site: ☐ SAC10 ☒ SAC3

Distance: ☐ 1 m ☒ 3 m ☐ 10 m ☐ 30 m

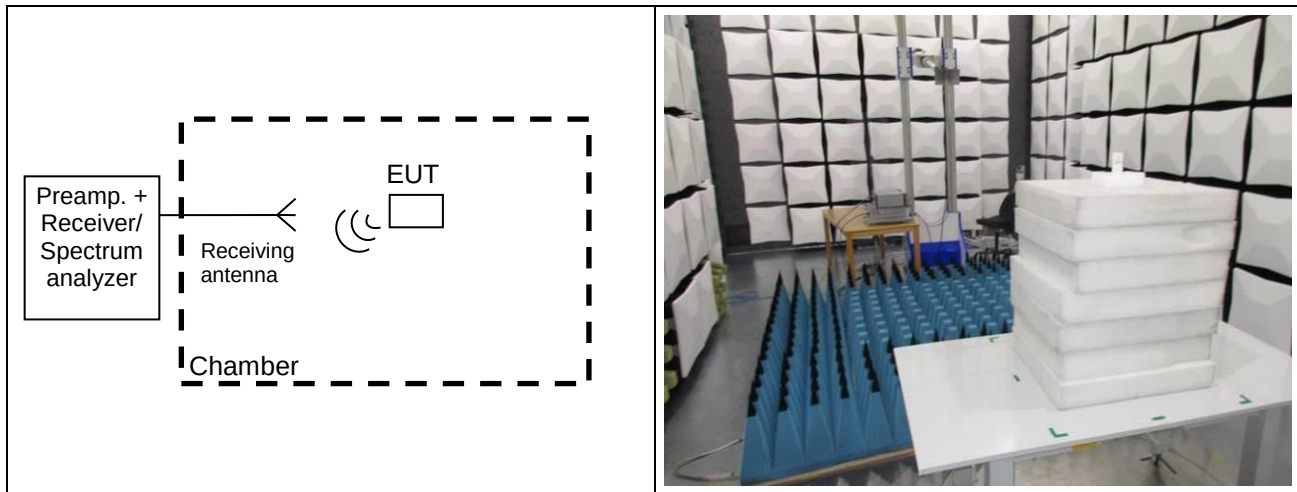
Position of EUT: 1.5 m (height of the equipment under test above floor)

Meas. uncertainty: ± 4.7 dB

Test method: The electromagnetic disturbance radiated by the equipment is measured using a spectrum analyzer and a wide band antenna. The antenna is placed at the same height as the EUT successively with horizontal and vertical polarizations, and aimed at the source by tilting. The turning table is operated through 360° during the measurements. The recordings are carried out taking into account the maximum value of all the disturbances appearing while the EUT is under test.

Limit: 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)

Test set-up:



Remarks: Limit values expressed in dB μ V/m and transformed to a measuring distance of 3 m (factor used = 20 dB/decade) if necessary
e.g.: for f = 40 MHz the limit is 500 μ V/m at 3 m;

$$20\log\left(\frac{500\frac{\mu V}{m}}{1\frac{\mu V}{m}}\right)=54\frac{dB\mu V}{m} \text{ at } 3m$$

Test equipment:

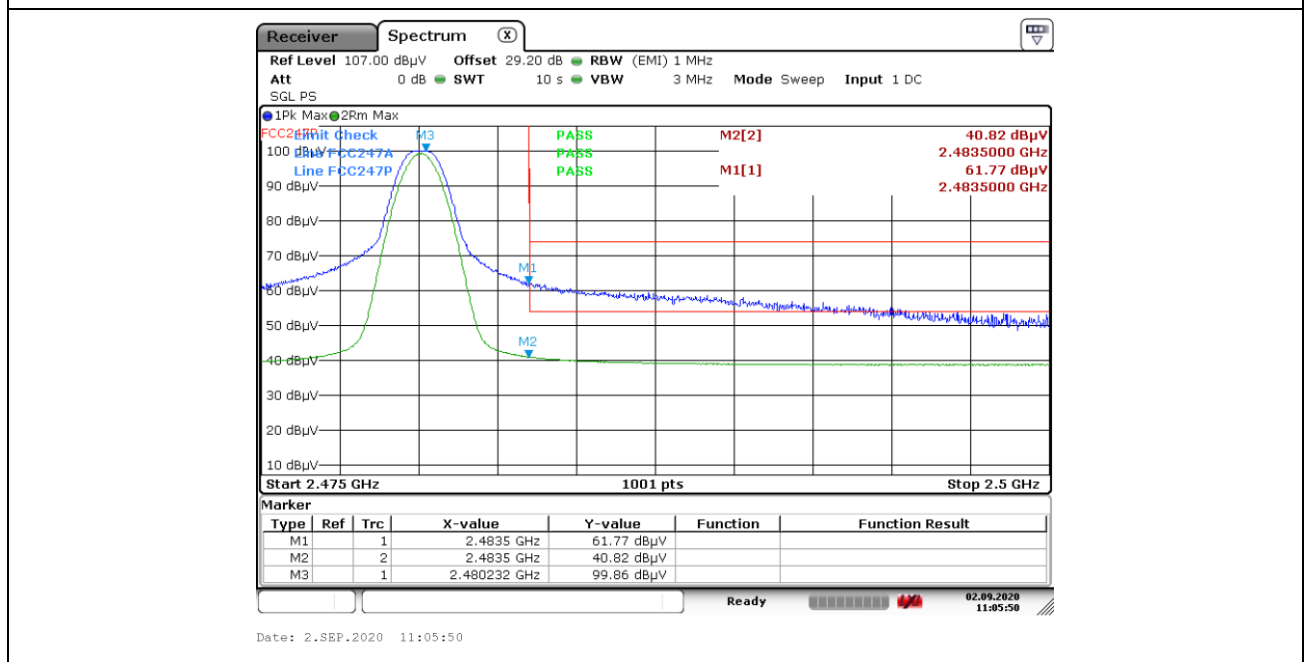
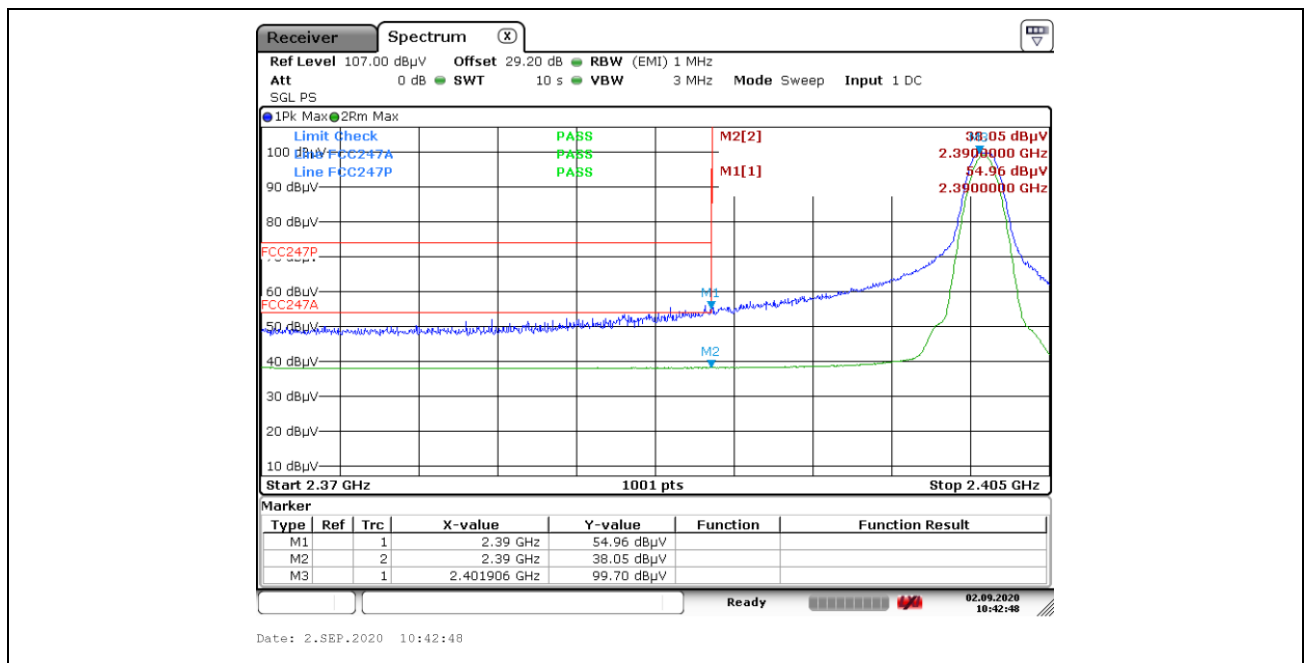
Spectrum analyzer	☐ 88-14	☐ 94-24	☐ 02-06	☐ 03-45	☒ 16-03	☐ 07-53
Preamplifier	☐ 05-56	☐ 05-87	☐ 14-27			
Antenna (horn)	☐ 90-24	☒ 07-31				
Cables	☒ 11-30	☐ 06-00C				
Software and Revision	☒ Vitam, Rev. 2.4.13	☐ RadiMation 2015.1.7				

Result: ☒ pass ☐ fail ☐ not applicable ☐ not tested

Results of the test

Applicant: modum.io AG
 EUT: MODsense T, DUT -06/B
 Operating mode: TX (f = 2.402/2.480 GHz), modulated, Pmax (4 dBm)
 Remarks: RefLev Offset is the sum of cable attenuation and antenna factor : 1.3 + 27.9 = 29.2 dB to convert voltage measurement [in dBμV] to E-Field value [in dBμV/m]. 1001 Point
 Modifications: ☒ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
 Climatic conditions: Temperature: 22 – 25 °C Humidity: 35 – 50 % Pressure QFE: 930 – 940 hPa

	Measured field strength [dBμV/m]		Limit [dBμV/m]	Margin [dB]		Pass	
	≤2390.0 MHz	≥2483.5 MHz		≤2390.0 MHz	≥2483.5 MHz	Yes	No
Peak detector	54.96	61.77	74	19.04	12.23	☒	☐
Average RMS detector	38.05	40.82	54	15.95	13.18	☒	☐



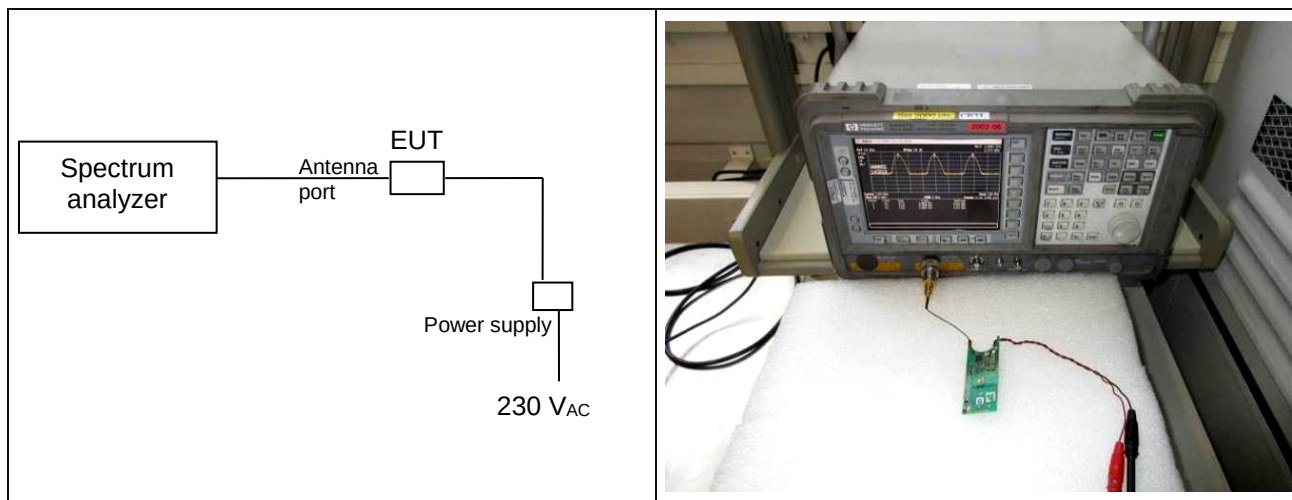
Place and date of test:
 Operator:

Rossens, 2020-09-02
 B. Itzcovich

6.6 Maximum power spectral density

Introduction:	The maximum power spectral density is defined as the highest power level in Watts per Hertz generated by the transmitter within the power envelope.
Test site:	☐ anechoic chamber (foam) ☐ open test site ☐ anechoic chamber (ferrites) ☒ laboratory
Meas. uncertainty:	$\pm 1.3 \text{ dB}$ ($f < 300 \text{ MHz}$) / $\pm 1.6 \text{ dB}$ ($f > 300 \text{ MHz}$)
Test method:	Measurement at the antenna connector or a test fixture, according to KDB 558074 §8.4
Limit:	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

Test set-up:



Remarks: ---

Test equipment:

Spectrum analyzer	☐ 88-14	☐ 94-24	☒ 02-06	☐ 03-45	☐ 05-39	☐ 07-53
Power supply	☒ 99-07	☐ 04-31				
Multimeter	☒ 09-11					
Cables	☐ 11-13					

Result: ☒ pass ☐ fail ☐ not applicable ☐ partly tested

Results of the test

Applicant: modum.io AG

Apparatus: MODsense T, DUT-11/B

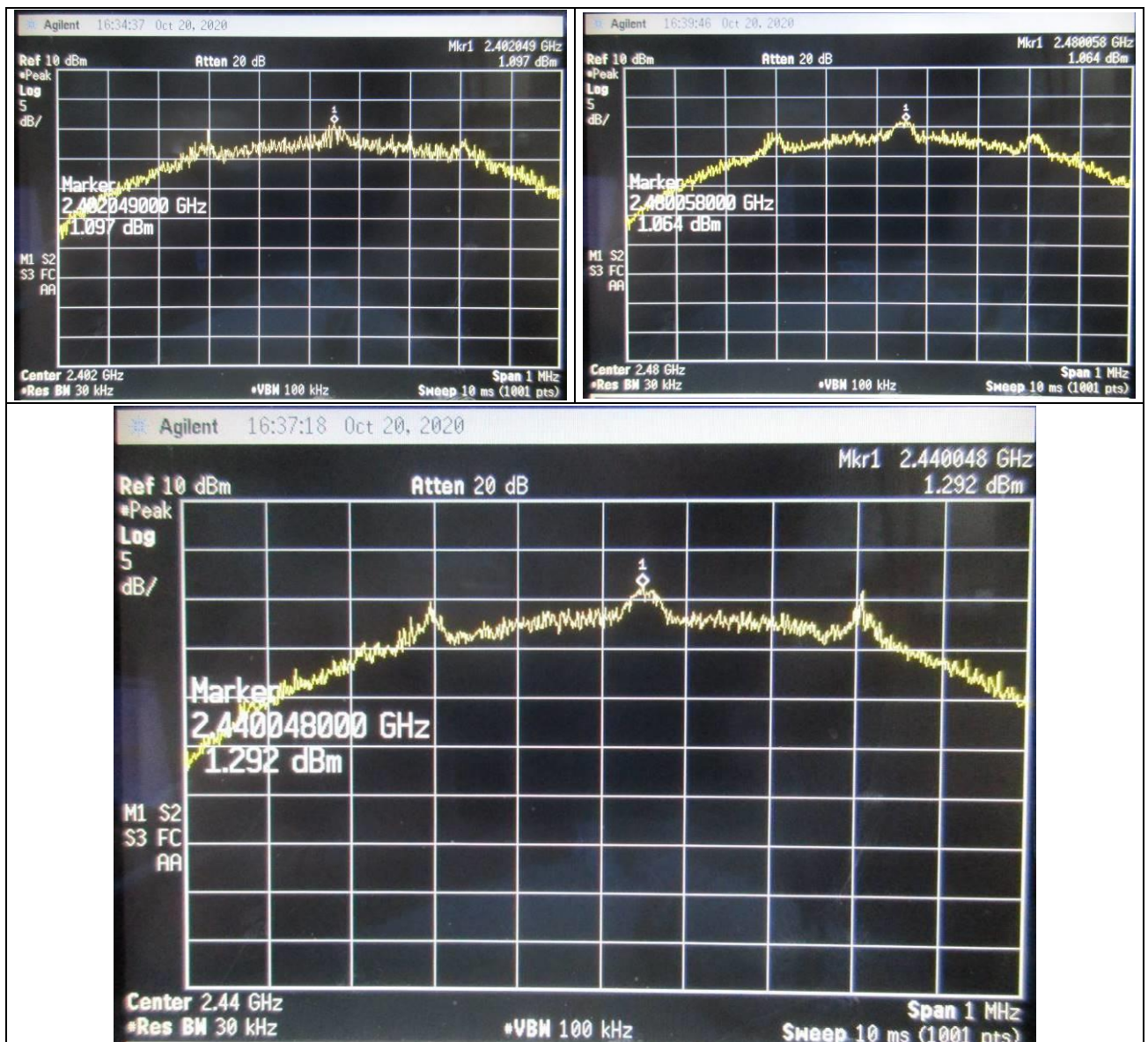
Operating mode: TX (f = 2.402 / 2.440 / 2.480 GHz), modulated, Pmax (4 dBm)

Remarks: Measured on temporary antenna connector

Modifications: ☒ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Climatic conditions: Temperature: 22 – 25 °C Humidity: 35 – 50 % Pressure QFE: 930 – 940 hPa

f [GHz]	Peak power [dBm]	Limit [dBm/3kHz]	Pass	
			Yes	No
2.402	1.10	8	☒	☐
2.440	1.29	8	☒	☐
2.480	1.06	8	☒	☐

Place and date of test:
Operator:Rossens, 2020-10-20
B. Itzcovich

6.7 Spurious emission – conducted (transmitter – 9 kHz to 26 GHz)

Test site: ☐ SAC3 ☐ open test site
☐ SAC10 ☒ laboratory

Meas. uncertainty: 9kHz – 3GHz: ± 1 dB
 3GHz – 6.7GHz: ± 2.1 dB
 6.7GHz – 13.2GHz: ± 2.6 dB
 13.2GHz – 19GHz: ± 2.8 dB
 19GHz – 26.5GHz: ± 3 dB

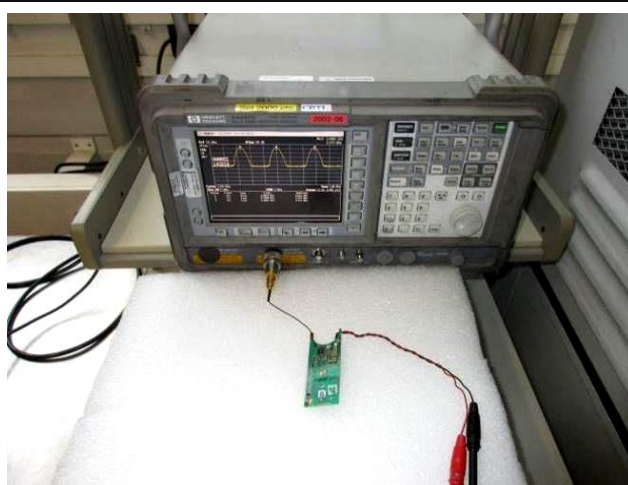
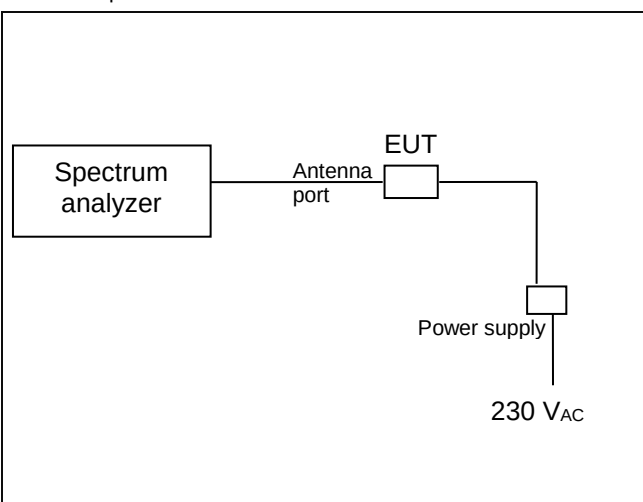
Test method: Measurement of the conducted power on the antenna connector or a test fixture.

Limit: In any 100 kHz bandwidth outside the frequency band, the radio frequency power 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

Modifications: ☒ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Climatic conditions: Temperature: 22 – 25 °C Humidity: 35 – 50 % Pressure QFE: 930 – 940 hPa

Test set-up:



Remarks: Emissions near band-edges are checked under § 6.4

Test equipment:

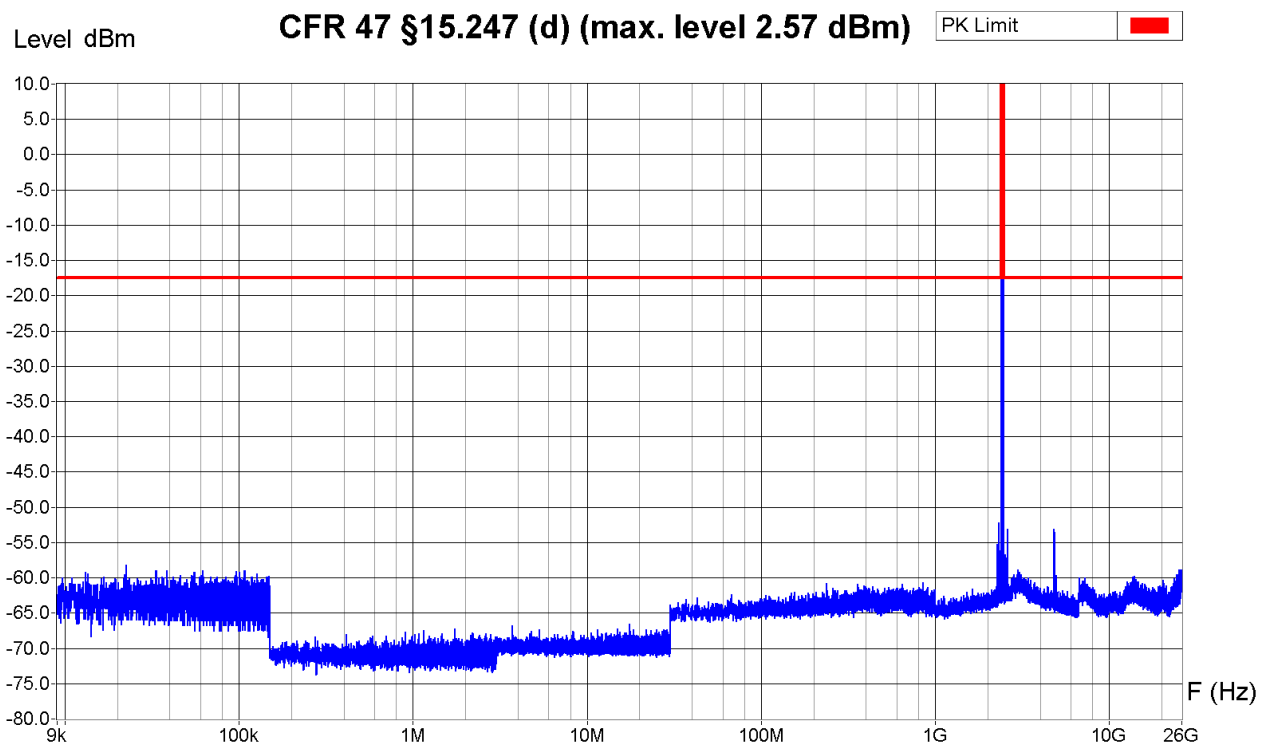
Spectrum analyzer	☐ 88-14	☐ 94-24	☒ 02-06	☐ 03-45	☐ 05-39	☐ 07-53
Power supply	☒ 99-07	☐ 04-31				
Multimeter	☒ 09-11					
Cables	☐ 11-13					
Software and Revision	☒ Vitam, Rev. 2.4.13	☐ RadiMation 2015.1.7				

Result: ☒ pass ☐ fail ☐ not applicable ☐ not tested

Measurement Type : Power Interference
Port : Temporary antenna connector
Clamp position : -



Equipment Under Test : MODsense T2 DUT-11/B
Set-Up : Powered with external power supply (3.0 VDC). See photos
Operating Conditions : Hopping TX (f = 2.40, 2.44, 2.48 GHz) , max. power (4 dBm), modulated
Remarks : I2C active
Peak detector sweep, 8001 Pts/zone
RBW = 100 kHz (for f >= 30 MHz), VBW = 300 kHz



Operator: B. Itzcovich
Date/Time: 21.10.2020 09:20
Filename:
CP_9k-26G_TX3f_4dBm.png/.txt

6.8 Spurious emission transmit mode – radiated

6.8.1 9 kHz to 30 MHz

Test site: ☒ SAC3 ☐ open test site
☐ SAC10 ☐

Distance: ☒ 3 m ☐ 10 m ☐ 30 m

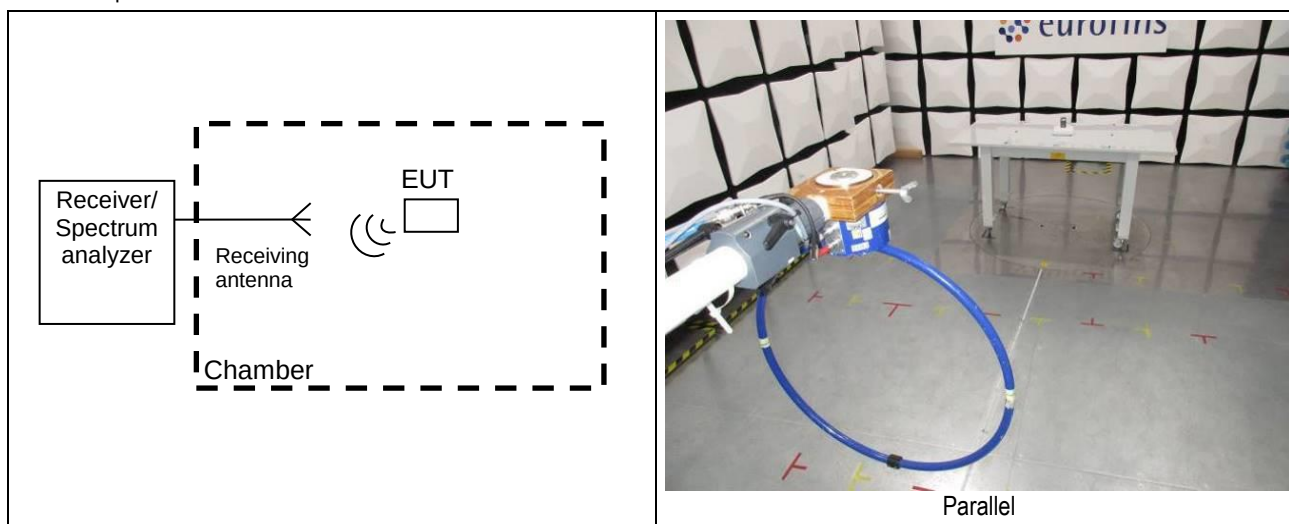
Position of EUT: 0.8 m (height of the equipment under test above floor)

Meas. uncertainty: ± 2.8 dB

Test method: The magnetic disturbance radiated by the equipment under test is measured using a spectrum analyzer and a wide band magnetic antenna. The antenna is placed at 1 m height, first in the direction of the apparatus under test, then at 90° to the apparatus and if required also horizontally. If possible the turning table is operated through 360° during the measurement. The recording is carried out taking into account the maximum value of the disturbance appearing during the functioning of the apparatus under test. The peak values are recorded continuously on a graph. The values exceeding the limits are re-measured using a measuring receiver.

Modifications: ☒ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
 Climatic conditions: Temperature: 22 – 25 °C Humidity: 35 – 50 % Pressure QFE: 930 – 940 hPa

Test set-up:



Remarks: Limit values expressed in dB μ V/m and transformed to a measuring distance of 3 m (factor used = 40 dB/decade) if necessary
 e.g.: for f = 10 MHz the limit is 30 μ V/m at 30 m;

$$20\log\left(\frac{30\frac{\mu V}{m}}{1\frac{\mu V}{m}}\right) + 40\log\left(\frac{30m}{3m}\right) = 69.5\frac{dB\mu V}{m} \text{ at } 3m$$

“Parallel” means measurement antenna axis towards EUT

Test equipment:

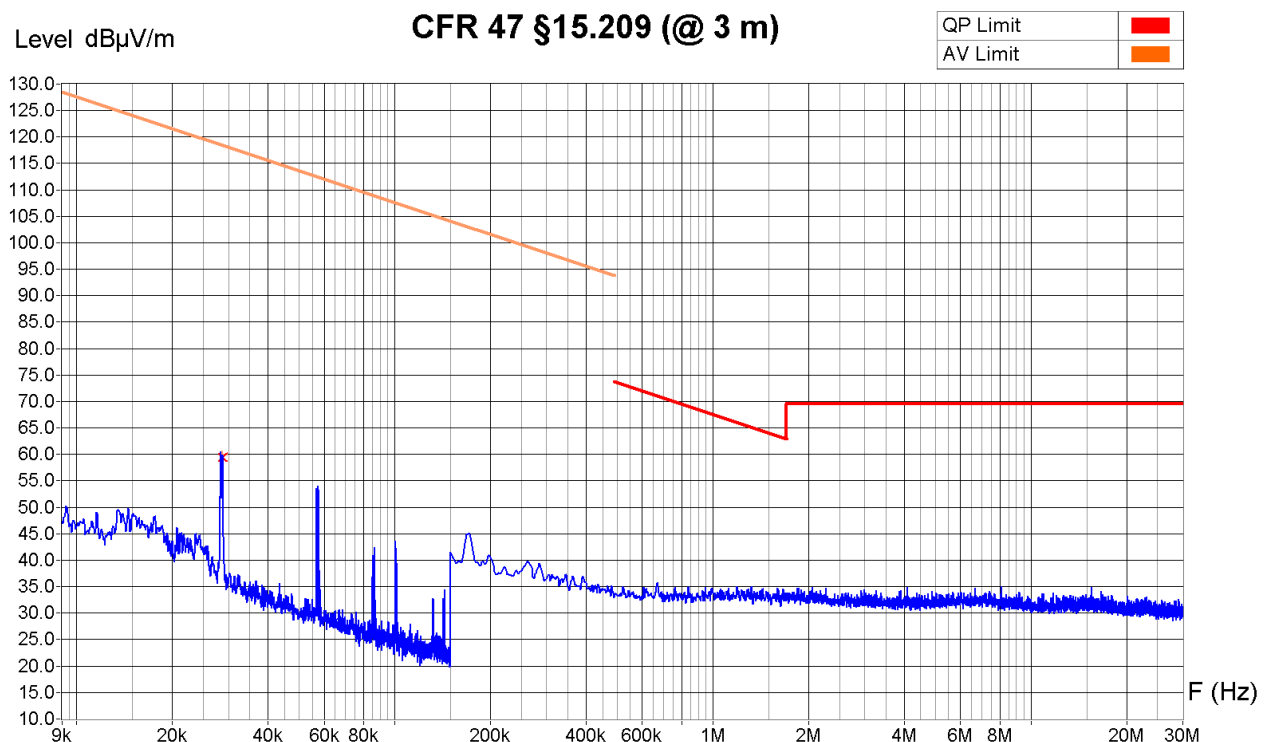
Spectrum analyzer	☐ 88-14	☐ 94-24	☐ 02-06	☐ 03-45	☐ 05-39	☒ 16-03
Receiver	☐ 85-04	☐ 90-43	☐ 94-35	☒ 16-03		
Preamplifier	☐ 90-01	☐ 95-86	☐ 05-56	☐ 05-59	☐ 05-62	
Antenna (type: magnetic)	☒ 90-25	☐ 90-28	☐ 99-32	☐ 04-79		
Cable set	☒ SAC3_RE_1.0/2.0/3.0		☐ 06-00C			
Software and Revision	☒ Vitam, Rev. 2.4.13		☐ RadiMation 2015.1.7			

Result: ☒ pass ☐ fail ☐ not applicable ☐ not tested

Measurement Type : Radiated Field
Polarisation : Perpendicular
Table Angle : 0 - 360°
Antenna Height : 1 m



Equipment Under Test : MODsense T2 DUT10/B
Set-Up : EUT standing on table (h = 0.8 m). See photos
Operating Conditions : Hopping TX (f = 2.40, 2.44, 2.48 GHz) , max. power (4 dBm), modulated
Remarks : I2C active



Zone	9 KHz - 150 KHz	150 KHz - 6 MHz	6 MHz - 30 MHz
Video Bandwidth	500 Hz	30 KHz	30 KHz
Resol Bandwidth	200 Hz	9 KHz	9 KHz

Receiver Measures

Frequency	Peak	QuasiPeak (x)	Average (+)
28.80 KHz	61.3 dBμV/m	59.4 dBμV/m	60.0 dBμV/m

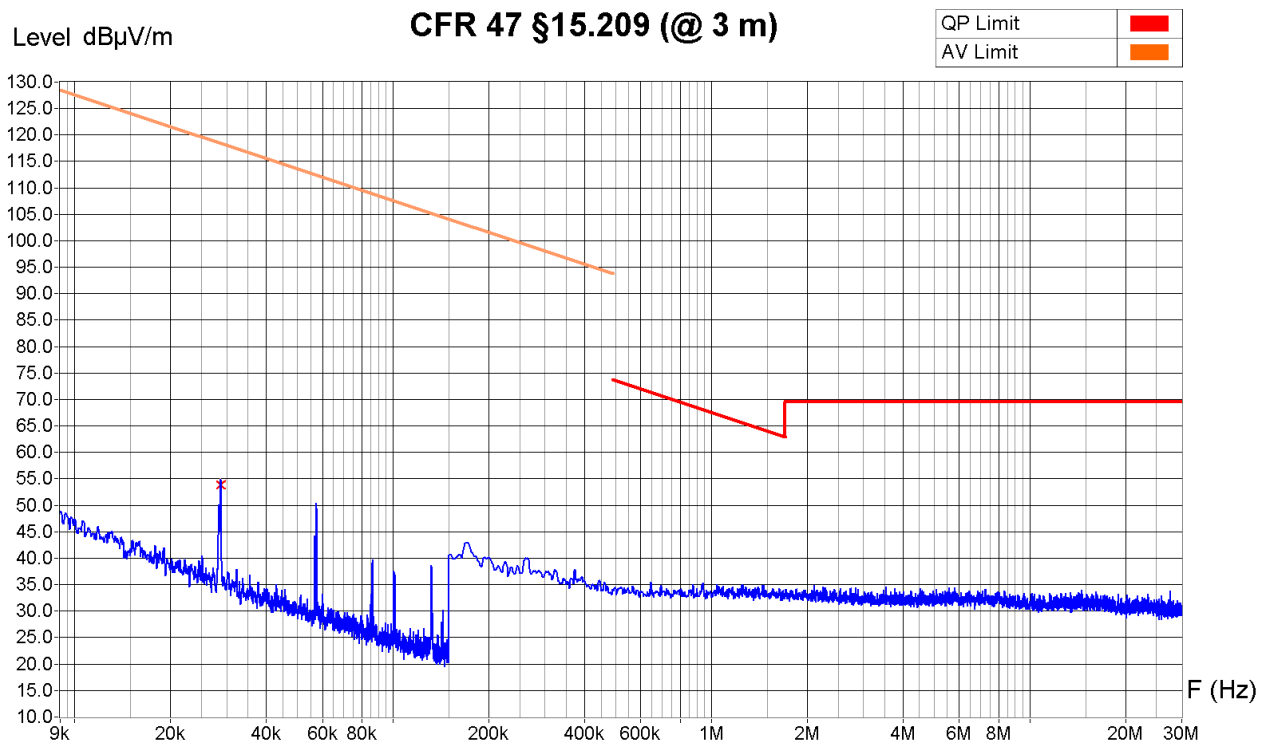
Sample calculation with all conversion and correction factors used					
Frequency [kHz]	Receiver AVG value [dBμV]	Cable att. corr. [dB]	Preamp. gain corr. [dB]	Antenna factor corr. [dB]	AVG field [dBμV/m]
28.8	39.2	+0.2	0.0	+20.6	= 60.0

Operator: B. Itzcovich
Date/Time: 20.10.2020 12:17
Filename:
24_RH_150k-30M_TX3f+
I2C_FCC_Per.png/.txt

Measurement Type : Radiated Field
Polarisation : Parallel
Table Angle : 0 - 360°
Antenna Height : 1 m



Equipment Under Test : MODsense T2 DUT10/B
Set-Up : EUT standing on table (h = 0.8 m). See photos
Operating Conditions : Hopping TX (f = 2.40, 2.44, 2.48 GHz) , max. power (4 dBm), modulated
Remarks : I2C active



Zone	9 KHz - 150 KHz	150 KHz - 6 MHz	6 MHz - 30 MHz
Video Bandwidth	500 Hz	30 KHz	30 KHz
Resol Bandwidth	200 Hz	9 KHz	9 KHz

Receiver Measures

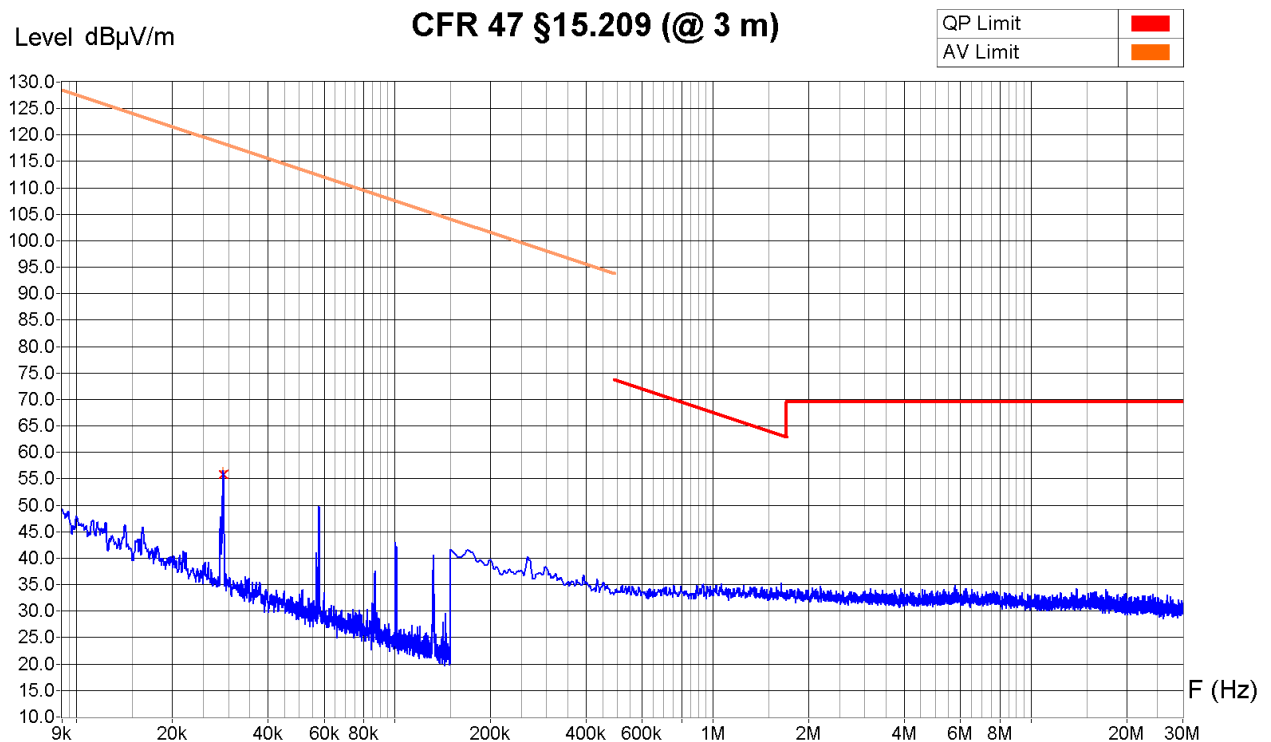
Frequency	Peak	QuasiPeak (x)	Average (+)
28.80 KHz	56.7 dBμV/m	53.8 dBμV/m	54.4 dBμV/m

Operator: B. Itzcovich
Date/Time: 20.10.2020 12:11
Filename:
23_RH_150k-30M_TX3f+
I2C_FCC_Par.png/.txt

Measurement Type : Radiated Field
Polarisation : Horizontal
Table Angle : 0 - 360°
Antenna Height : 1 m



Equipment Under Test : MODsense T2 DUT10/B
Set-Up : EUT standing on table (h = 0.8 m). See photos
Operating Conditions : Hopping TX (f = 2.40, 2.44, 2.48 GHz) , max. power (4 dBm), modulated
Remarks : I2C active



Zone	9 KHz - 150 KHz	150 KHz - 6 MHz	6 MHz - 30 MHz
Video Bandwidth	500 Hz	30 KHz	30 KHz
Resol Bandwidth	200 Hz	9 KHz	9 KHz

Receiver Measures

Frequency	Peak	QuasiPeak (x)	Average (+)
28.90 KHz	57.7 dBμV/m	55.8 dBμV/m	56.4 dBμV/m

Operator: B. Itzcovich
Date/Time: 20.10.2020 12:28
Filename:
25_RH_150k-30M_TX3f+
I2C_FCC_Hor.png/.txt

6.8.2 30 MHz to 1 GHz

Test site: ☒ SAC3 ☐ open test site
☐ SAC10 ☐

Distance: ☒ 3 m ☐ 10 m ☐ 30 m

Position of EUT: 0.8 m (height of the equipment under test above floor)

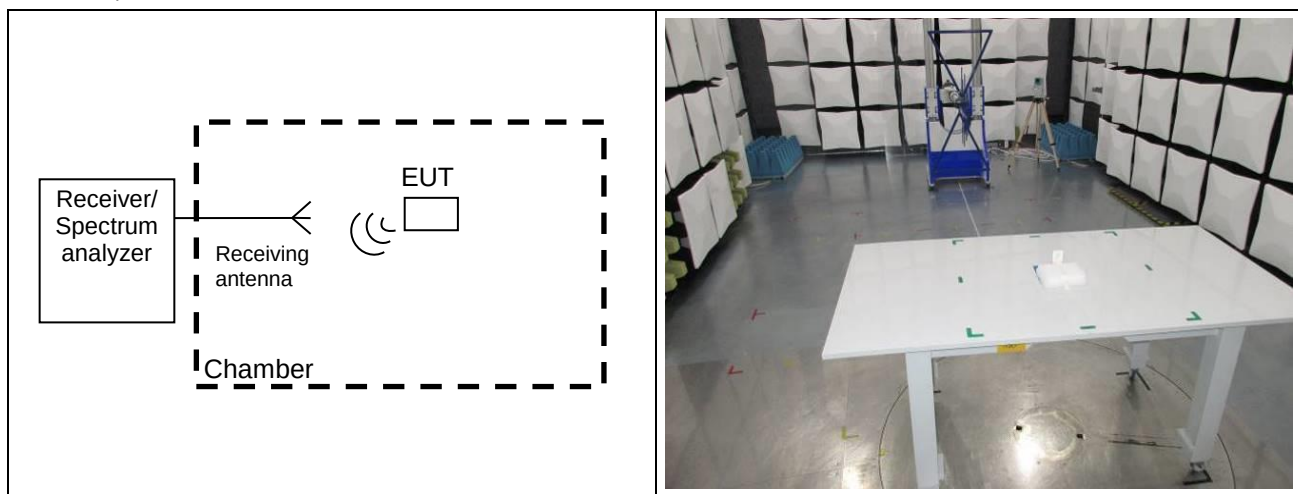
Meas. uncertainty: ± 4.6 dB (30 - 300 MHz) / ± 3.7 dB (300 - 1000 MHz)

Test method: The electromagnetic disturbance radiated by the equipment is measured using a spectrum analyzer and a wide band antenna. The antenna is moved from 1 to 4 m in height successively with horizontal and vertical polarizations. The turning table is operated through 360° during the measurements. The recordings are carried out taking into account the maximum value of all the disturbances appearing while the apparatus is under test. The peak values are recorded continuously on the graph. The values exceeding a limit are re-measured manually using a receiver.

Modifications: ☒ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Climatic conditions: Temperature: 22 – 25 °C Humidity: 35 – 50 % Pressure QFE: 930 – 940 hPa

Test set-up:



Remarks: Limit values expressed in dB μ V/m and transformed to a measuring distance of 3m (factor used = 20 dB/decade) if necessary
 e.g.: for f = 40 MHz the limit is 100 μ V/m at 3 m;

$$20 \log \left(\frac{100 \frac{\mu V}{m}}{1 \frac{\mu V}{m}} \right) = 40 \frac{dB \mu V}{m} \text{ at } 3m$$

Test equipment:

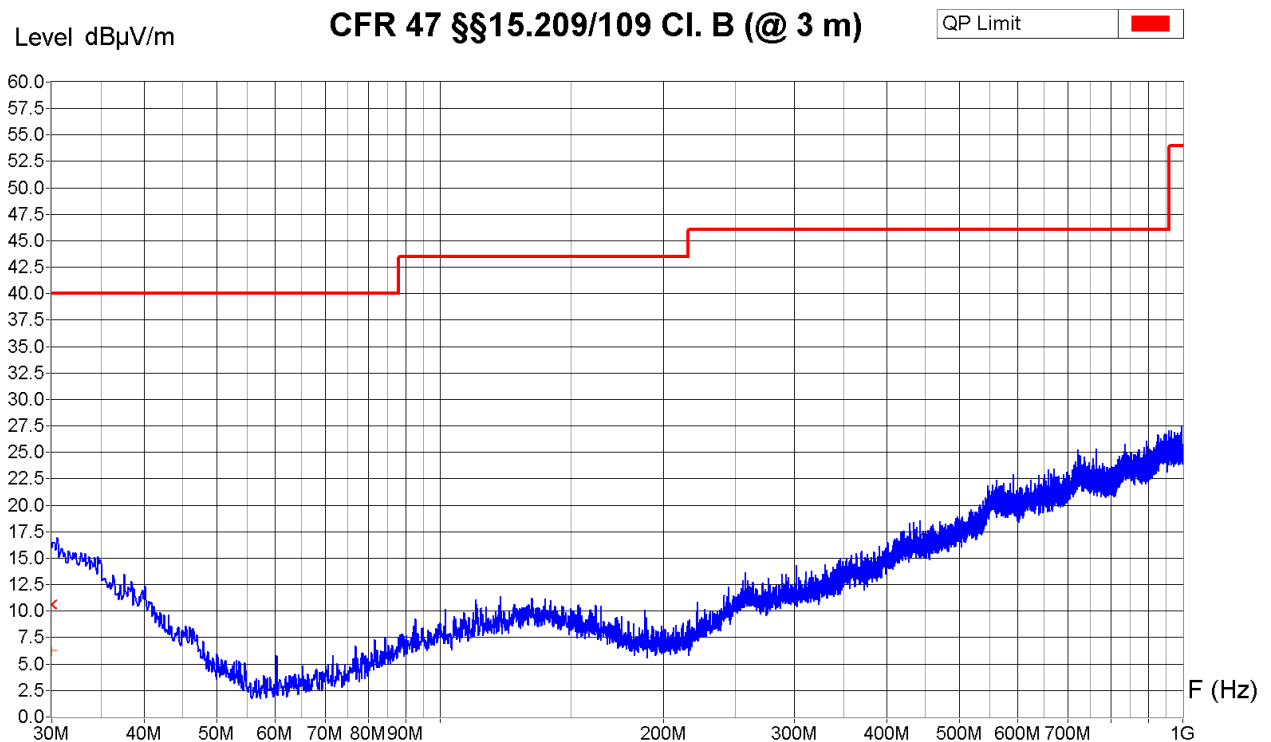
Spectrum analyzer	☐ 88-14	☐ 94-24	☐ 02-06	☐ 03-45	☐ 05-39	☒ 16-03
Receiver	☐ 85-04	☐ 90-43	☐ 94-35	☐ 04-29	☒ 16-03	
Preamplifier	☐ 90-01	☐ 95-86	☐ 05-56	☐ 05-59	☒ 16-03 internal	
Antenna (bilog)	☐ 94-03	☒ 05-38				
Cable set	☒ SAC3_RE_1.0/2.0/3.0		☐ 06-00C			
Software and Revision	☒ Vitam, Rev. 2.4.13		☐ RadiMation 2015.1.7			

Result: ☒ pass ☐ fail ☐ not applicable ☐ not tested

Measurement Type : Radiated Field
Polarisation : Vertical
Table Angle : 0 - 360°
Antenna Height : 1 - 4m



Equipment Under Test : MODsense T2 DUT-06/B
Set-Up : EUT standing on table (h = 0.8 m). See photos
Operating Conditions : Hopping TX (f = 2.40, 2.44, 2.48 GHz) , max. power (4 dBm), modulated
Remarks : I2C not active



Zone	30 MHz - 1 GHz
Video Bandwidth	500 KHz
Resol Bandwidth	120 KHz

Receiver Measures

Frequency	Peak	QuasiPeak (x)	Average (+)	QP Margin
30 MHz	19.6 dBμV/m	10.6 dBμV/m	6.2 dBμV/m	29.4 dB

Sample calculation with all conversion and correction factors used

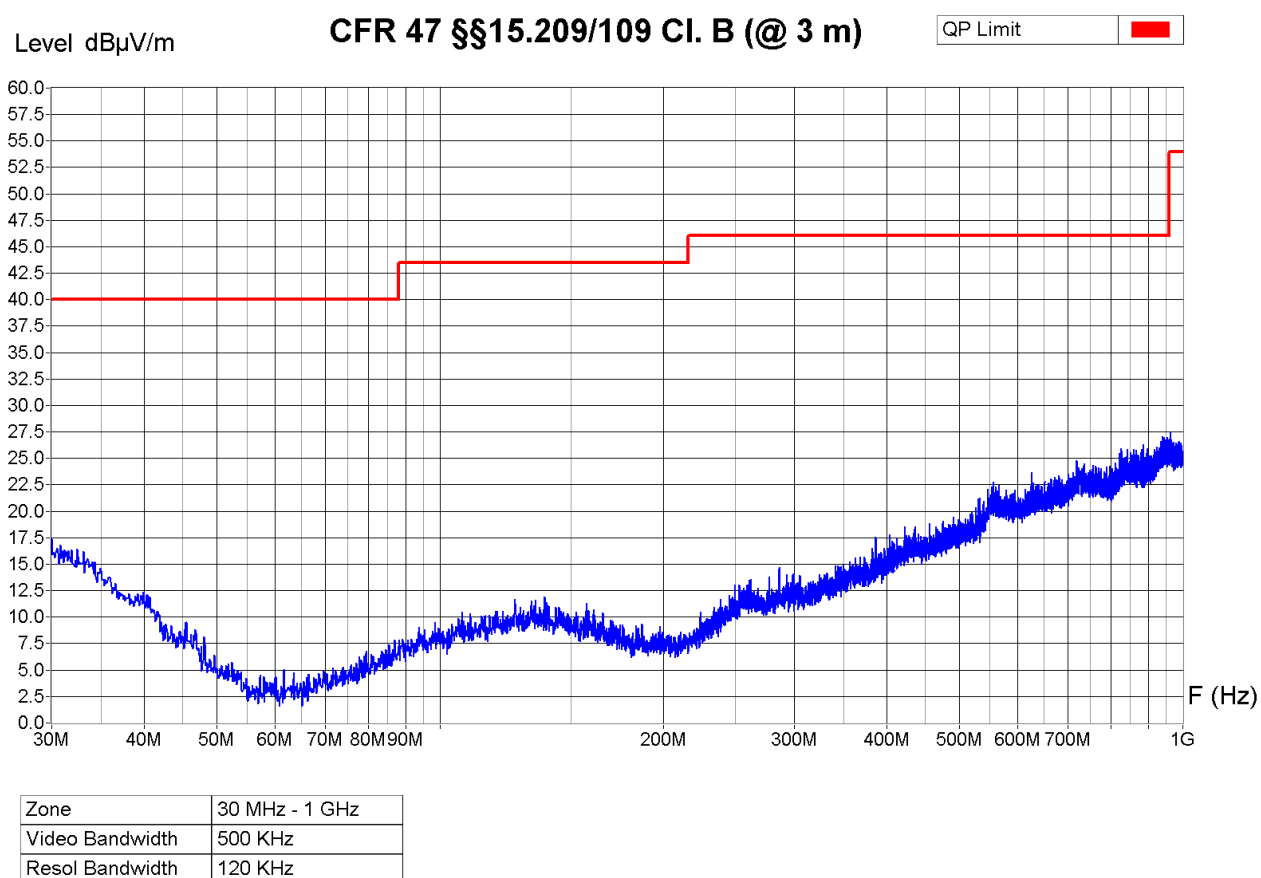
Frequency [MHz]	Receiver QP value [dBμV]	Cable att. corr. [dB]	Preamp. gain corr. [dB]	Antenna factor corr. [dB]	QP field [dBμV/m]
30.0	-7.5	+0.3	0.0	+17.8	= 10.6

Operator: B. Itzcovich
Date/Time: 01.09.2020 09:33
Filename:
01_RE_30M-
1G_TX3f_FCC_V.png/.txt

Measurement Type : Radiated Field
 Polarisation : Horizontal
 Table Angle : 0 - 360°
 Antenna Height : 1 - 4m



Equipment Under Test : MODsense T2 DUT-06/B
 Set-Up : EUT standing on table (h = 0.8 m). See photos
 Operating Conditions : Hopping TX (f = 2.40, 2.44, 2.48 GHz) , max. power (4 dBm), modulated
 Remarks : I2C not active

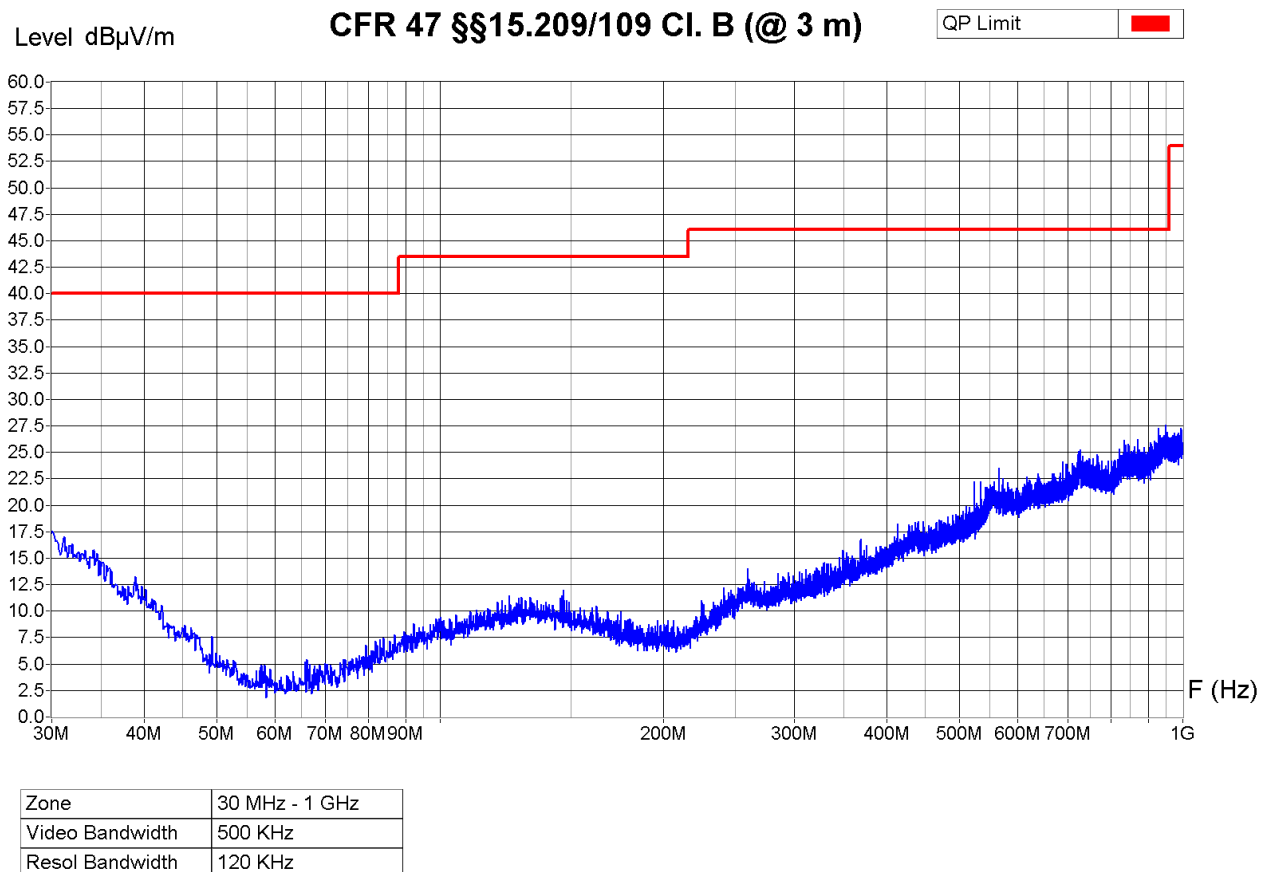


Operator: B. Itzcovich
 Date/Time: 01.09.2020 09:49
 Filename:
 02_RE_30M-
 1G_TX3f_FCC_H.png/.txt

Measurement Type : Radiated Field
Polarisation : Vertical
Table Angle : 0 - 360°
Antenna Height : 1 - 4m



Equipment Under Test : MODsense T2 DUT-07/B
Set-Up : EUT standing on table (h = 0.8 m). See photos
Operating Conditions : Advertizing TX (f = 2.40, 2.43, 2.48 GHz) , max. power, modulated
Remarks : I2C active

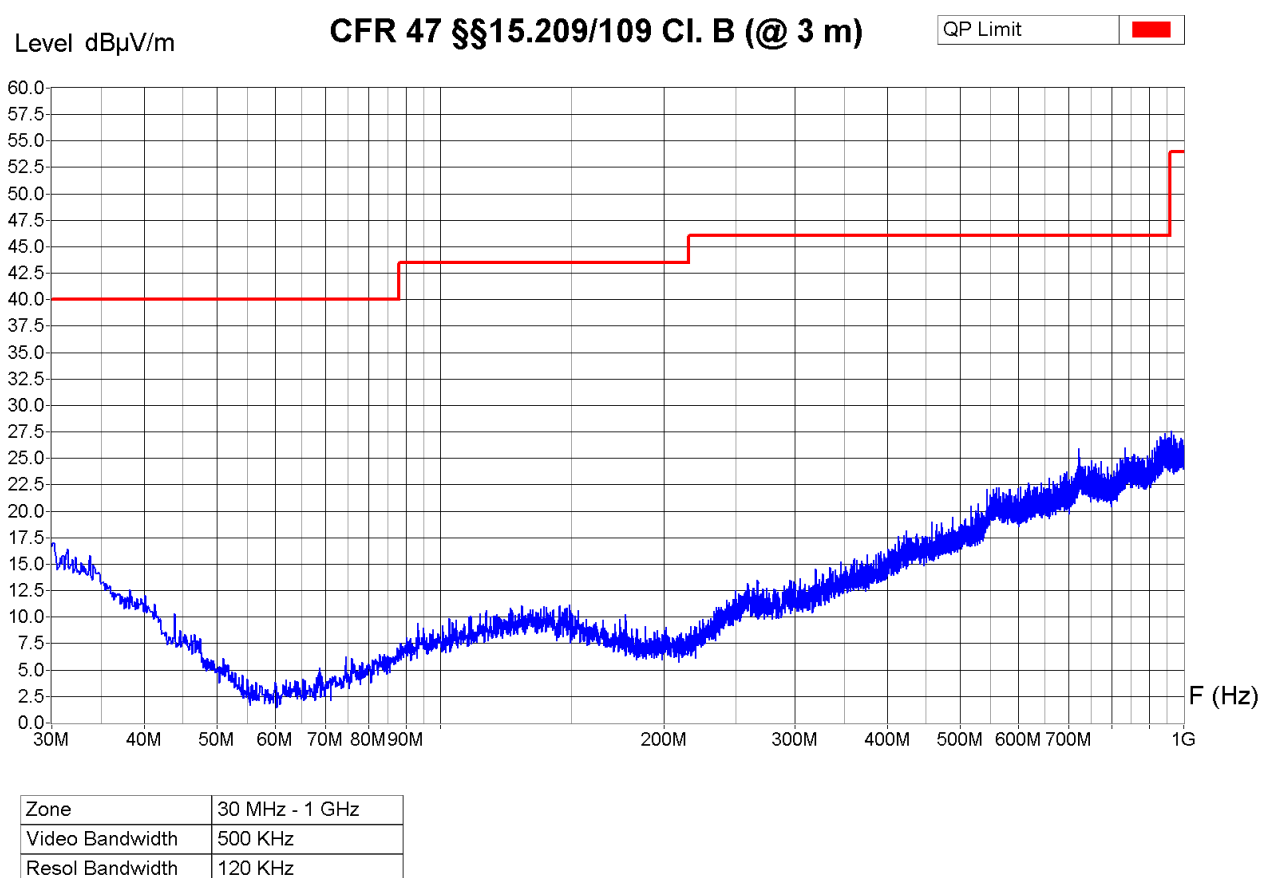


Operator: B. Itzcovich
Date/Time: 01.09.2020 10:07
Filename:
03_RE_30M-1G_I2C+
TX3f_FCC_V.png/.txt

Measurement Type : Radiated Field
 Polarisation : Horizontal
 Table Angle : 0 - 360°
 Antenna Height : 1 - 4m



Equipment Under Test : MODsense T2 DUT-07/B
 Set-Up : EUT standing on table (h = 0.8 m). See photos
 Operating Conditions : Advertizing TX (f = 2.40, 2.43, 2.48 GHz) , max. power, modulated
 Remarks : I2C active



Operator: B. Itzcovich
 Date/Time: 01.09.2020 10:14
 Filename:
 04_RE_30M-1G_I2C+
 TX3f_FCC_H.png/.txt

6.8.3 1 GHz to 18 GHz

Test site: ☐ SAC10 ☒ SAC3

Distance: ☒ 1 m ☐ 3 m ☐ 10 m ☐ 30 m

Position of EUT: 1.5 m (height of the equipment under test above floor)

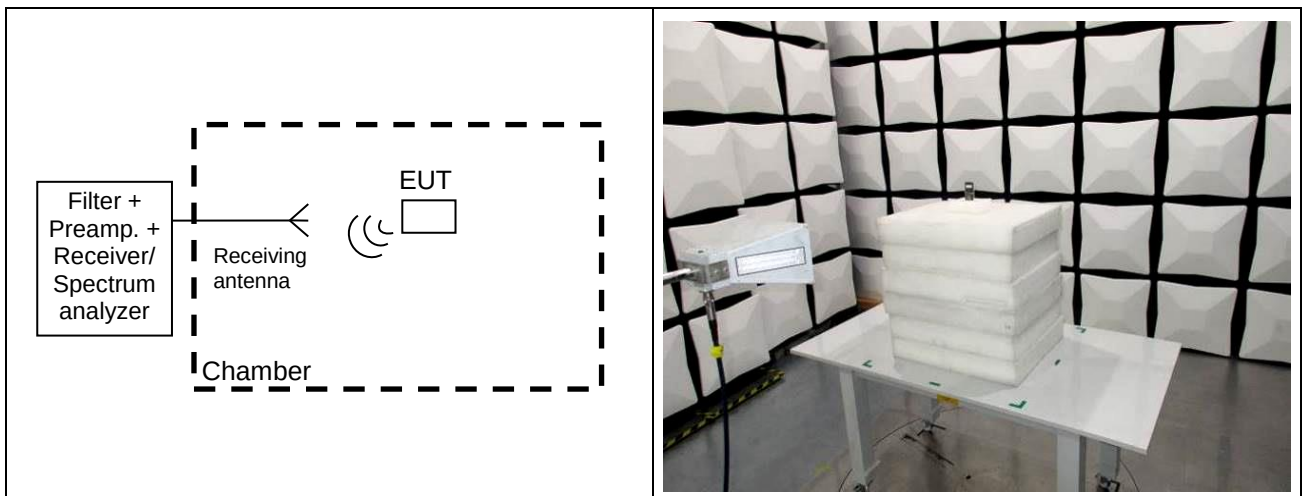
Meas. uncertainty: ± 4.7 dB

Test method: The electromagnetic disturbance radiated by the equipment is measured using a spectrum analyzer and a wide band antenna. The antenna is moved from 1 to 4 m in height successively with horizontal and vertical polarizations, and aimed at the source by tilting. The turning table is operated through 360° during the measurements. The recordings are carried out taking into account the maximum value (peak) of all the disturbances appearing while the apparatus is under test.

Modifications: ☒ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Climatic conditions: Temperature: 22 – 25 °C Humidity: 35 – 50 % Pressure QFE: 930 – 940 hPa

Test set-up:



Remarks:

- Limit values expressed in dB μ V/m and transformed to a measuring distance of 1m (factor used = 20 dB/decade) if necessary. E.g.: for f = 1 GHz the limit is 500 μ V/m at 3 m;

$$20\log\left(\frac{500\frac{\mu V}{m}}{1\frac{\mu V}{m}}\right) + 20\log\left(\frac{3m}{1m}\right) = 635\frac{dB\mu V}{m} \text{ at } 1m$$
- Emissions near band-edges are checked under §§ 6.4 and 6.5
- Average measurements determined from the peak field strength after correcting for the worst-case duty cycle according to § 4.1.4.2.4 of ANSI C63.10:2013. Correction factor: $\delta(dB) = 20\log(\Delta) = 20\log(0.57) = -4.88$ dB

Test equipment:

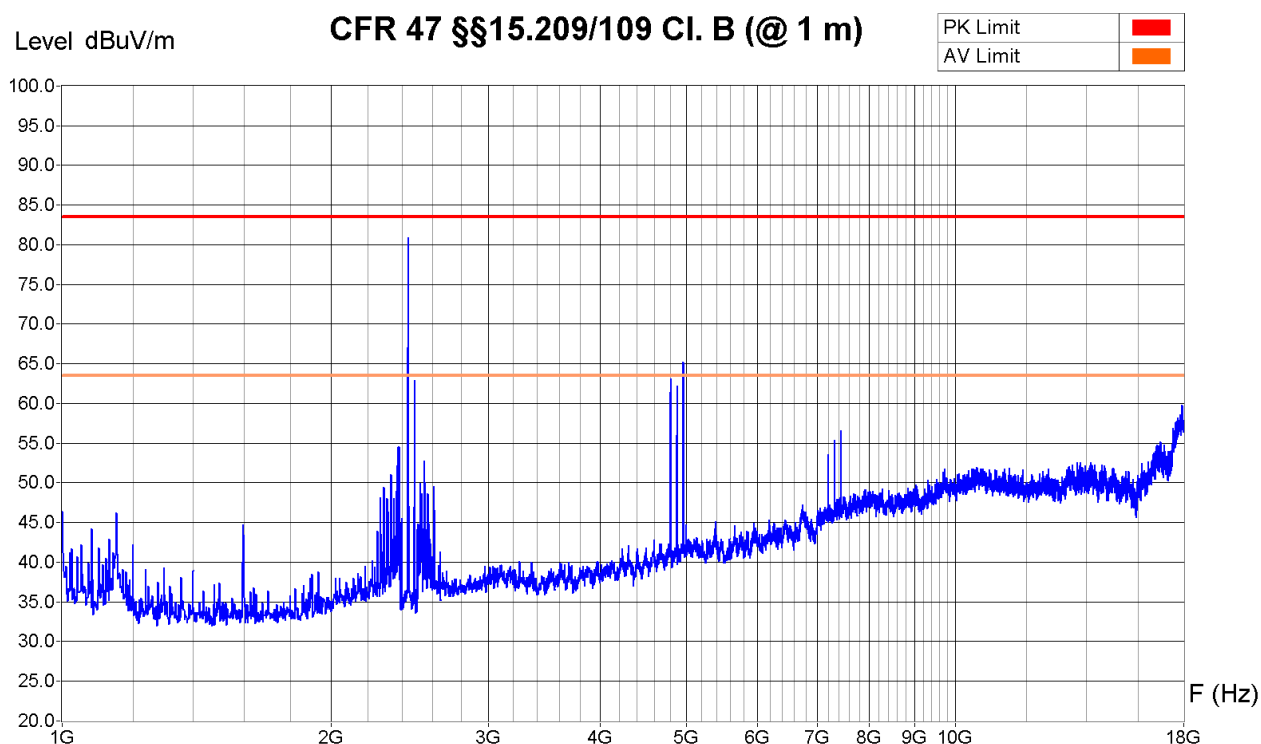
Spectrum analyzer	☐ 88-14	☐ 94-24	☒ 02-06	☐ 03-45	☐ 05-39	☐ 07-53
Preamplifier	☐ 05-56	☐ 05-87	☒ 14-27			
Antenna (horn)	☐ 90-24	☒ 07-31				
Cables	☒ 11-30	☒ 06-00C				
Filters	☒ 13-14	☒ 12-06	☐ 13-05			
Software and Revision	☒ Vitam, Rev. 2.4.13	☐ RadiMation 2015.1.7				

Result: ☒ pass ☐ fail ☐ not applicable ☐ not tested

Measurement Type : Radiated Field
 Polarisation : Vertical
 Table Angle : 0 - 360°
 Antenna Height : 1 - 3m (tilted)



Equipment Under Test : MODsense T2 DUT-06/B
 Set-Up : EUT standing on table (h = 1.5 m). See photos
 Operating Conditions : Hopping TX (f = 2.40, 2.44, 2.48 GHz) , max. power (4 dBm), modulated
 Remarks : Peak detector sweep, 3001 pts/zone
 Zone 1 - 7 GHz with preamp 14-27 and bandcut filter 13-14
 Zone 7 - 18 GHz with preamp 14-27 and HP filter 12-06



Zone	1 GHz - 7 GHz	7 GHz - 13 GHz	13 GHz - 18 GHz
Video Bandwidth	3 MHz	3 MHz	3 MHz
Resol Bandwidth	1 MHz	1 MHz	1 MHz

Sample calculation with all conversion and correction factors used						
Frequency [GHz]	Analyzer Peak value [dBuV]	Cable att. corr. [dB]	Preamp. gain corr. [dB]	Antenna factor corr. [dB]	Attenuator corr. [dB]	Peak field [dBuV/m]
4.960	70.4	+1.9	-39.3	+32.3	0.0	= 65.3

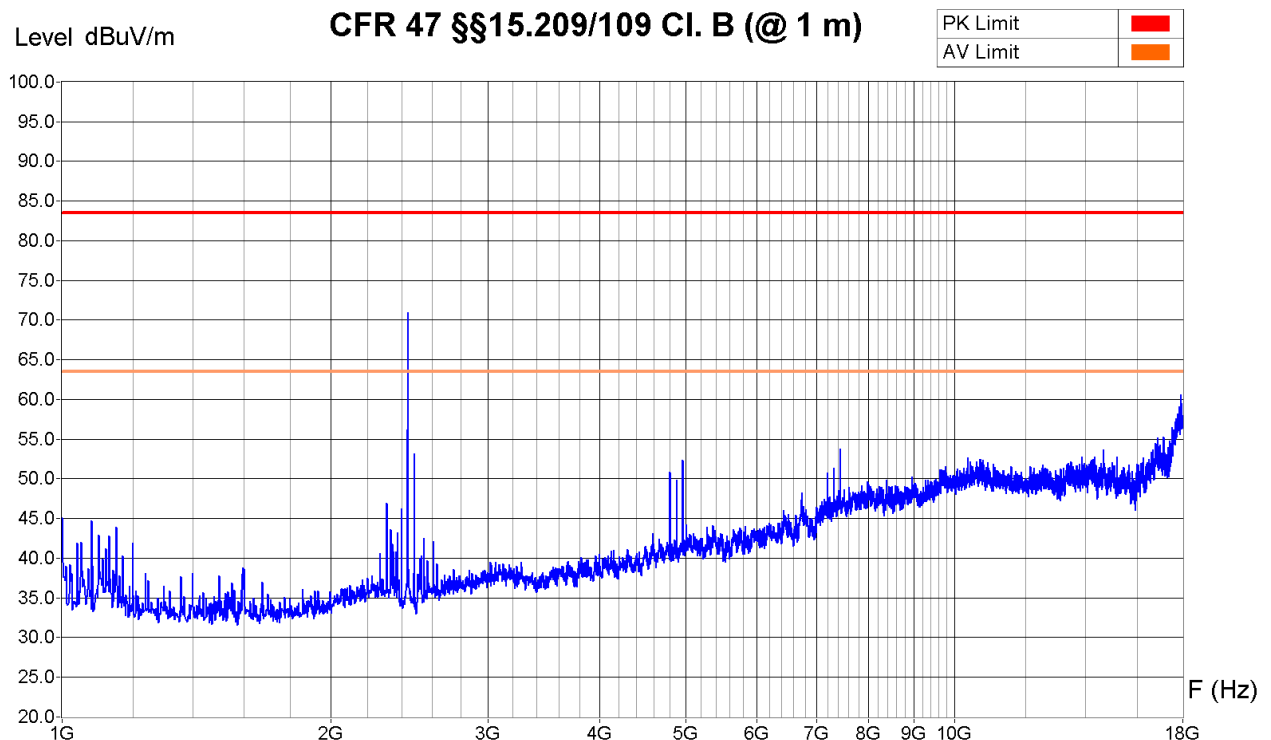
Final Result					
Frequency [GHz]	Peak field [dBuV/m]	Correction for Average [dB]	Calculated Average field [dBuV/m]	Average Limit [dBuV/m]	Conclusion
4.802	63.2	-4.9	58.3	63.5	Pass
4.880	62.2	-4.9	57.3	63.5	Pass
4.960	65.3	-4.9	60.4	63.5	Pass

Operator: B. Itzcovich
 Date/Time: 01.09.2020 11:57
 Filename:
 05_RE_1-18G_TX3f_FCC_V.png/
 .txt

Measurement Type : Radiated Field
Polarisation : Horizontal
Table Angle : 0 - 360°
Antenna Height : 1 - 3m (tilted)



Equipment Under Test : MODsense T2 DUT-06/B
Set-Up : EUT standing on table (h = 1.5 m). See photos
Operating Conditions : Hopping TX (f = 2.40, 2.44, 2.48 GHz) , max. power (4 dBm), modulated
Remarks : Peak detector sweep, 3001 pts/zone
Zone 1 - 7 GHz with preamp 14-27 and bandcut filter 13-14
Zone 7 - 18 GHz with preamp 14-27 and HP filter 12-06



Zone	1 GHz - 7 GHz	7 GHz - 13 GHz	13 GHz - 18 GHz
Video Bandwidth	3 MHz	3 MHz	3 MHz
Resol Bandwidth	1 MHz	1 MHz	1 MHz

Operator: B. Itzcovich
Date/Time: 01.09.2020 12:05
Filename:
06_RE_1-18G_TX3f_FCC_H.png/
.txt

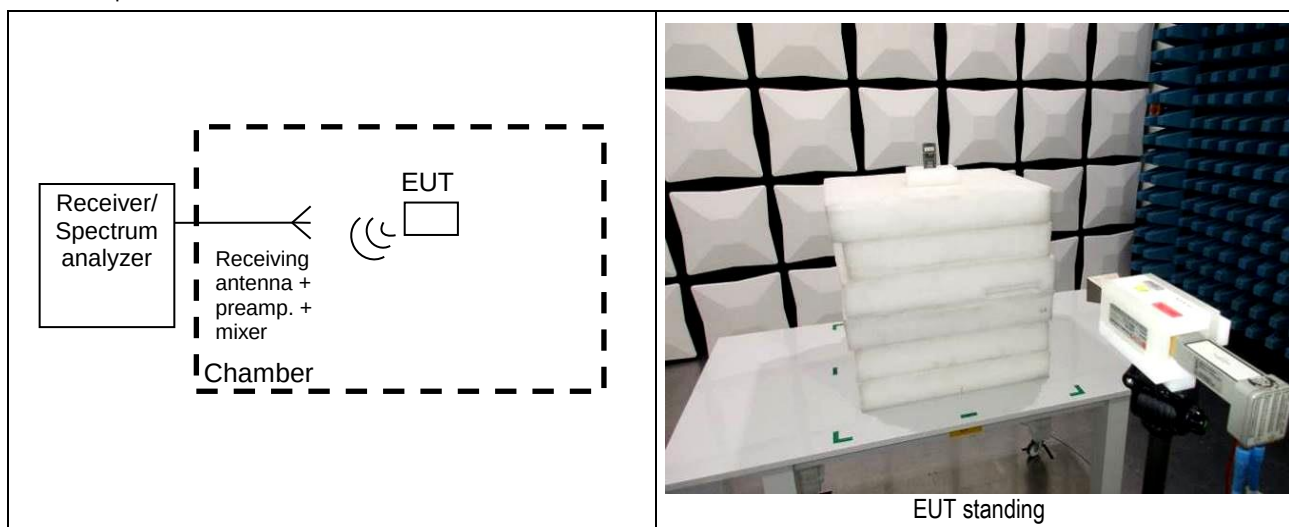
6.8.4 18 GHz to 26.5 GHz

Test site: ☒ SAC3 ☐ SAC10
 Distance: ☒ 1 m ☐ 3 m ☐ 10 m ☐ 30 m
 Position of EUT: 1.5 m (height of the equipment under test above floor)
 Meas. uncertainty: ± 4.7 dB

Test method: The electromagnetic disturbance radiated by the equipment is measured using a spectrum analyzer and a wide band antenna. The antenna is placed at the same height as the EUT successively with horizontal and vertical polarizations. The EUT is placed successively in lying and standing positions. The turning table is operated through 360° during the measurements. The recordings are carried out taking into account the maximum value (peak) of all the disturbances appearing while the apparatus is under test.

Modifications: ☒ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
 Climatic conditions: Temperature: 22 – 25 °C Humidity: 35 – 50 % Pressure QFE: 930 – 940 hPa

Test set-up:



Remarks: Limit values expressed in dB μ V/m and transformed to a measuring distance of 1m (factor used = 20 dB/decade) if necessary
 e.g.: for f = 18 GHz the limit is 500 μ V/m at 3 m;

$$20\log\left(\frac{500\frac{\mu V}{m}}{1\frac{\mu V}{m}}\right) + 20\log\left(\frac{3m}{1m}\right) = 635\frac{dB\mu V}{m} \text{ at } 1m$$

Test equipment:

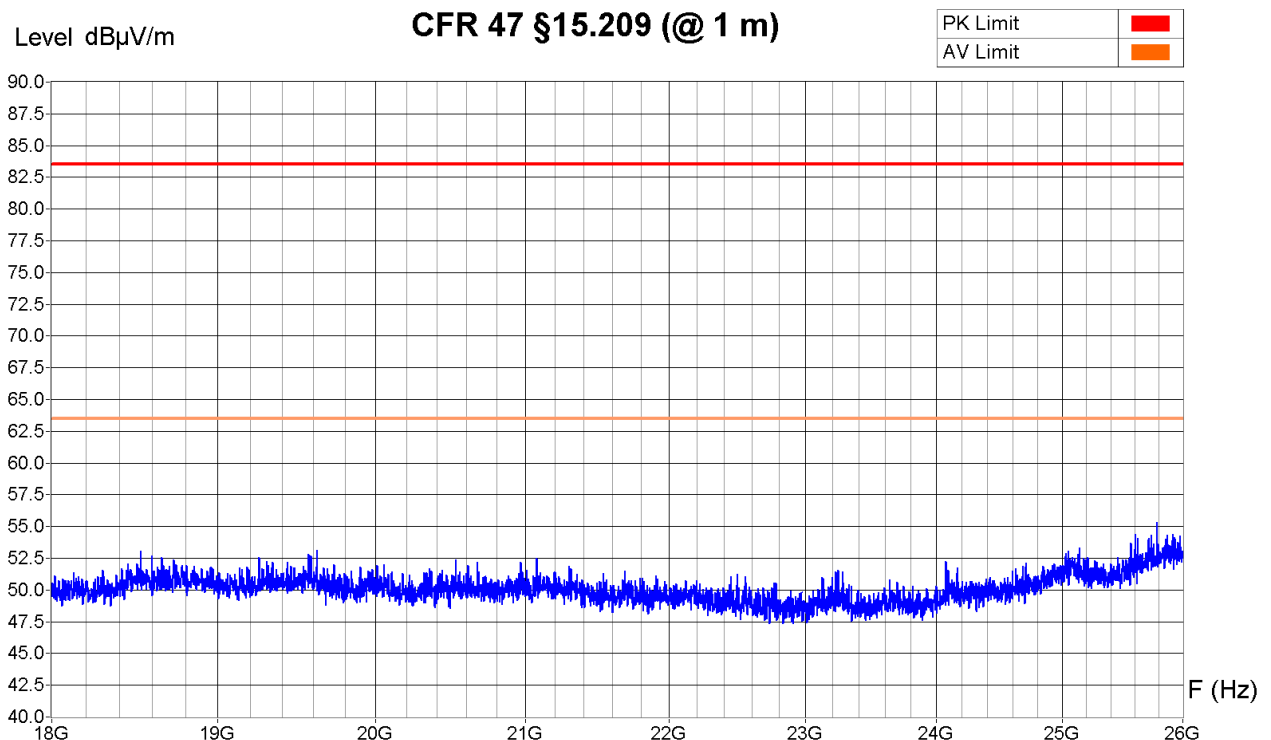
Spectrum analyzer	☐ 88-14	☐ 94-24	☒ 02-06	☐ 03-45	☐ 05-39	☐ 07-53
Antenna with mixer & preamp.	☒ 98-12					
Cables	☒ 11-62	☒ 10-81				
Power supply	☒ 06-62					
Software and Revision	☒ Vitam, Rev. 2.4.13		☐ RadiMation 2015.1.7			

Result: ☒ pass ☐ fail ☐ not applicable ☐ not tested

Measurement Type : Radiated Field
Polarisation : Vertical
Table Angle : 0 - 360°
Antenna Height : aligned with EUT



Equipment Under Test : MODsense T2 DUT-06/B
Set-Up : EUT standing on table (h = 1.5 m). See photos
Operating Conditions : Hopping TX (f = 2.40, 2.44, 2.48 GHz) , max. power (4 dBm), modulated
Remarks : Peak detector sweep, 4001 pts/zone



Zone	18 GHz - 26 GHz
Video Bandwidth	3 MHz
Resol Bandwidth	1 MHz

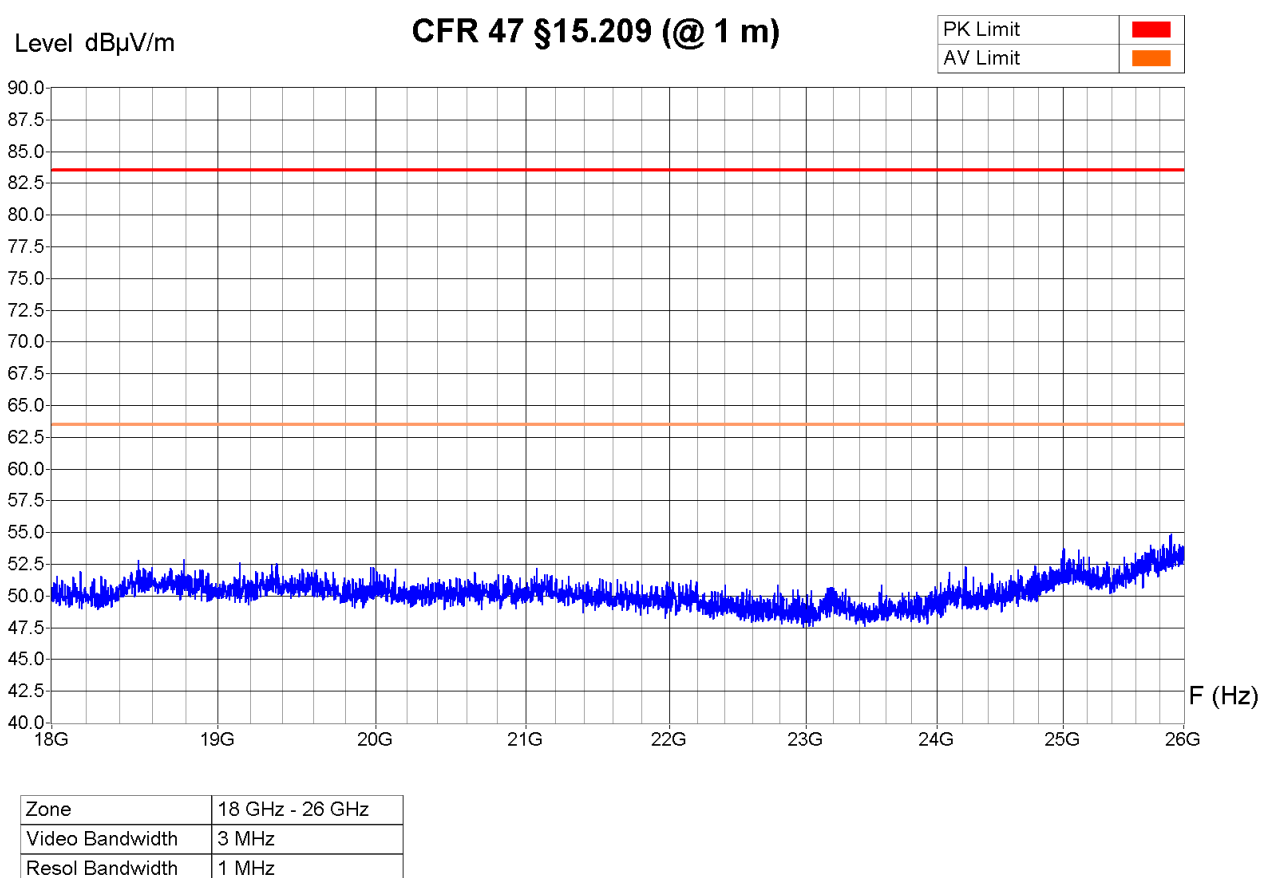
Sample calculation with all conversion and correction factors used				
Frequency [GHz]	Analyzer Peak value [dBμV]	Combined Cable att. + Preamp. gain + Antenna factor corr [dB]	Attenuator corr. [dB]	Peak field [dBμV/m]
25.784	30.5	+24.8	0.0	= 55.3

Operator: B. Itzcovich
Date/Time: 01.09.2020 14:54
Filename:
09_RE_18-
26G_TX3f_FCC_Stand_V.png/txt

Measurement Type : Radiated Field
 Polarisation : Horizontal
 Table Angle : 0 - 360°
 Antenna Height : aligned with EUT



Equipment Under Test : MODsense T2 DUT-06/B
 Set-Up : EUT standing on table (h = 1.5 m). See photos
 Operating Conditions : Hopping TX (f = 2.40, 2.44, 2.48 GHz) , max. power (4 dBm), modulated
 Remarks : Peak detector sweep, 4001 pts/zone

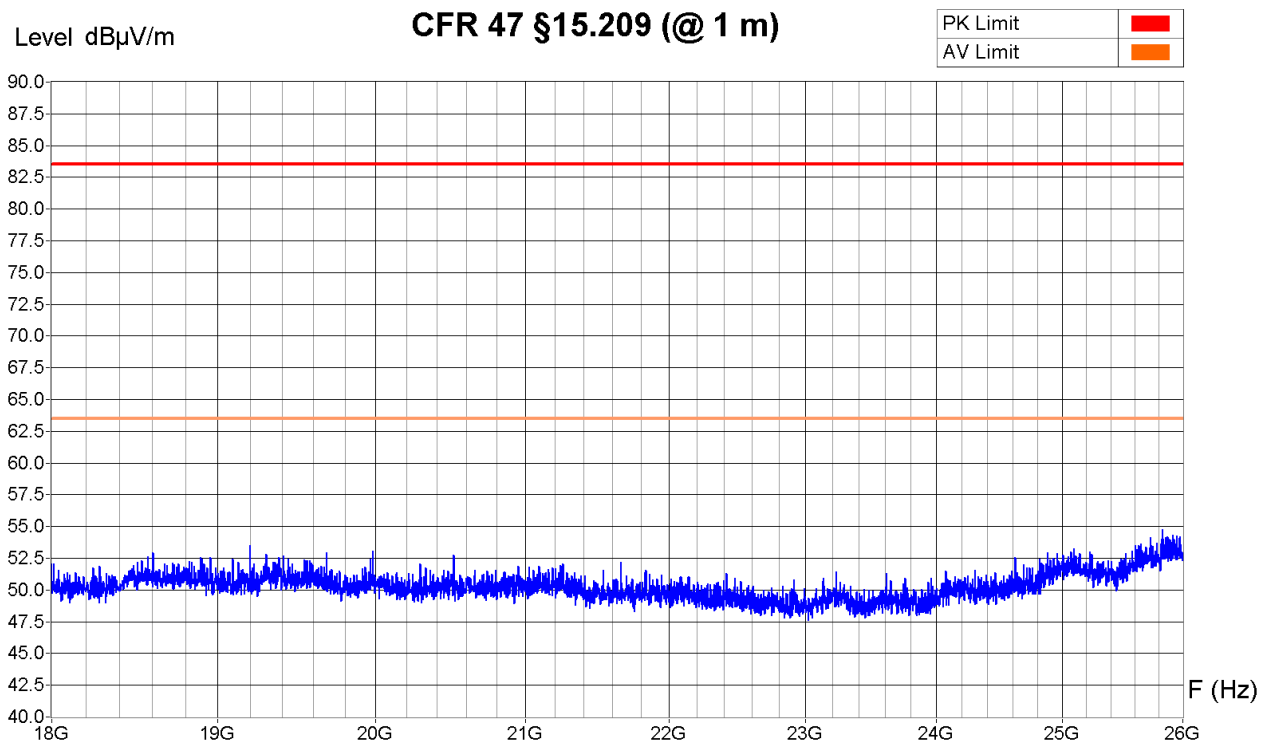


Operator: B. Itzcovich
 Date/Time: 01.09.2020 15:06
 Filename:
 10_RE_18-
 26G_TX3f_FCC_Stand_H.png/.txt

Measurement Type : Radiated Field
Polarisation : Vertical
Table Angle : 0 - 360°
Antenna Height : aligned with EUT



Equipment Under Test : MODsense T2 DUT-06/B
Set-Up : EUT lying on table (h = 1.5 m). See photos
Operating Conditions : Hopping TX (f = 2.40, 2.44, 2.48 GHz) , max. power (4 dBm), modulated
Remarks : Peak detector sweep, 4001 pts/zone



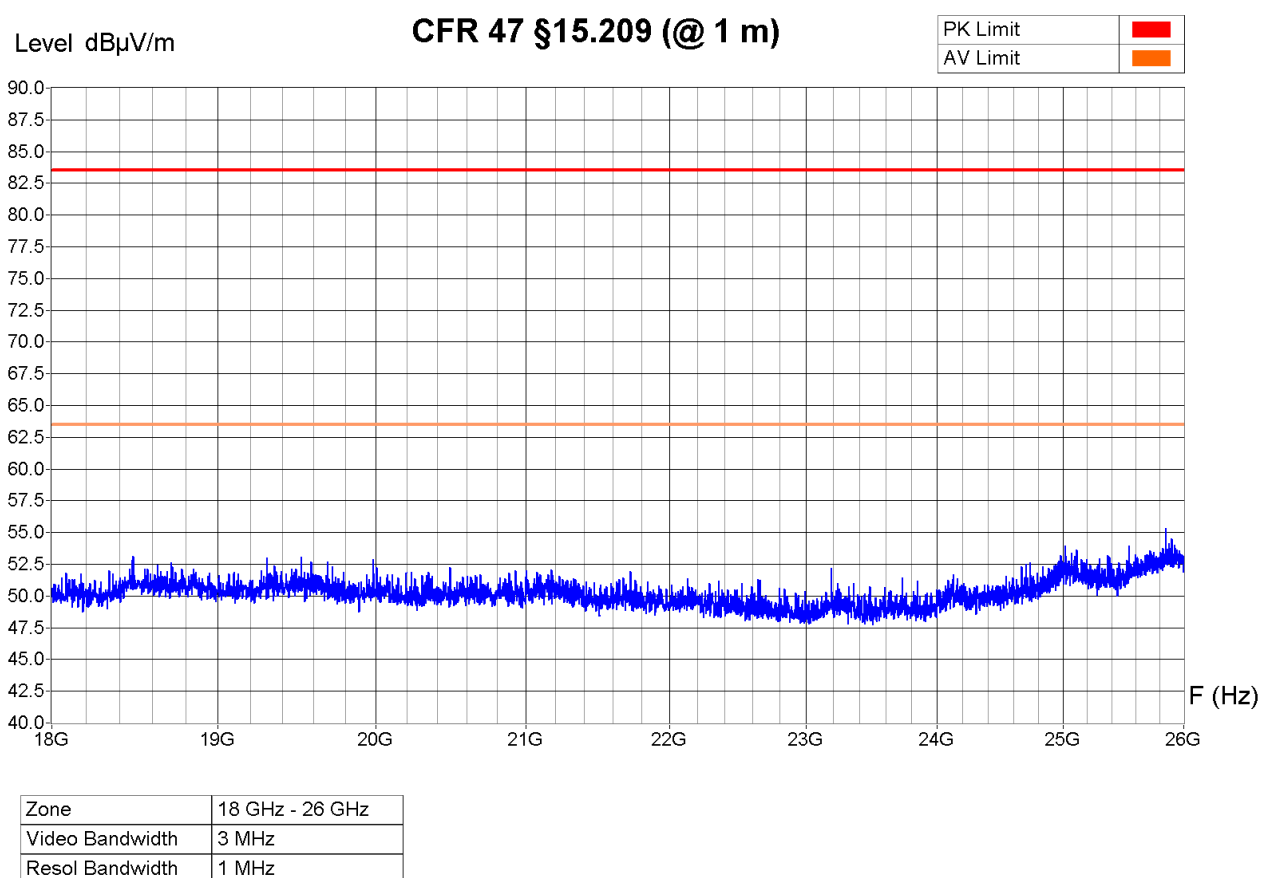
Zone	18 GHz - 26 GHz
Video Bandwidth	3 MHz
Resol Bandwidth	1 MHz

Operator: B. Itzcovich
Date/Time: 01.09.2020 15:00
Filename:
11_RE_18-
26G_TX3f_FCC_Lying_V.png/.txt

Measurement Type : Radiated Field
 Polarisation : Horizontal
 Table Angle : 0 - 360°
 Antenna Height : aligned with EUT



Equipment Under Test : MODsense T2 DUT-06/B
 Set-Up : EUT lying on table (h = 1.5 m). See photos
 Operating Conditions : Hopping TX (f = 2.40, 2.44, 2.48 GHz) , max. power (4 dBm), modulated
 Remarks : Peak detector sweep, 4001 pts/zone



Operator: B. Itzcovich
 Date/Time: 01.09.2020 15:03
 Filename:
 12_RE_18-
 26G_TX3f_FCC_Lying_H.png/.txt

6.9 Spurious emission receive mode - radiated**6.9.1 30 MHz to 1 GHz**

Test site: ☒ SAC3 ☐ open test site
☐ SAC10 ☐

Distance: ☐ 3 m ☒ 10 m ☐ 30 m

Position of EUT: 0.8 m (height of the equipment under test above floor)

Meas. uncertainty: ± 4.6 dB (30 - 300 MHz) / ± 3.7 dB (300 - 1000 MHz)

Test method: The electromagnetic disturbance radiated by the equipment is measured using a spectrum analyzer and a wide band antenna. The antenna is moved from 1 to 4 m in height successively with horizontal and vertical polarizations. The turning table is operated through 360° during the measurements. The recordings are carried out taking into account the maximum value of all the disturbances appearing while the apparatus is under test. The peak values are recorded continuously on the graph. The values exceeding a limit are re-measured manually using a receiver.

Modifications: ☒ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
 Climatic conditions: Temperature: 22 – 25 °C Humidity: 35 – 50 % Pressure QFE: 930 – 940 hPa

Test set-up:



Remarks: - Limit values expressed in dBμV/m and transformed to a measuring distance of 3m (factor used = 20 dB/decade) if necessary
 e.g.: for f = 40 MHz the limit is 100 μV/m at 3 m;

$$20 \log \left(\frac{100 \frac{\mu V}{m}}{1 \frac{\mu V}{m}} \right) = 40 \frac{dB \mu V}{m} \text{ at } 3m$$

Test equipment:

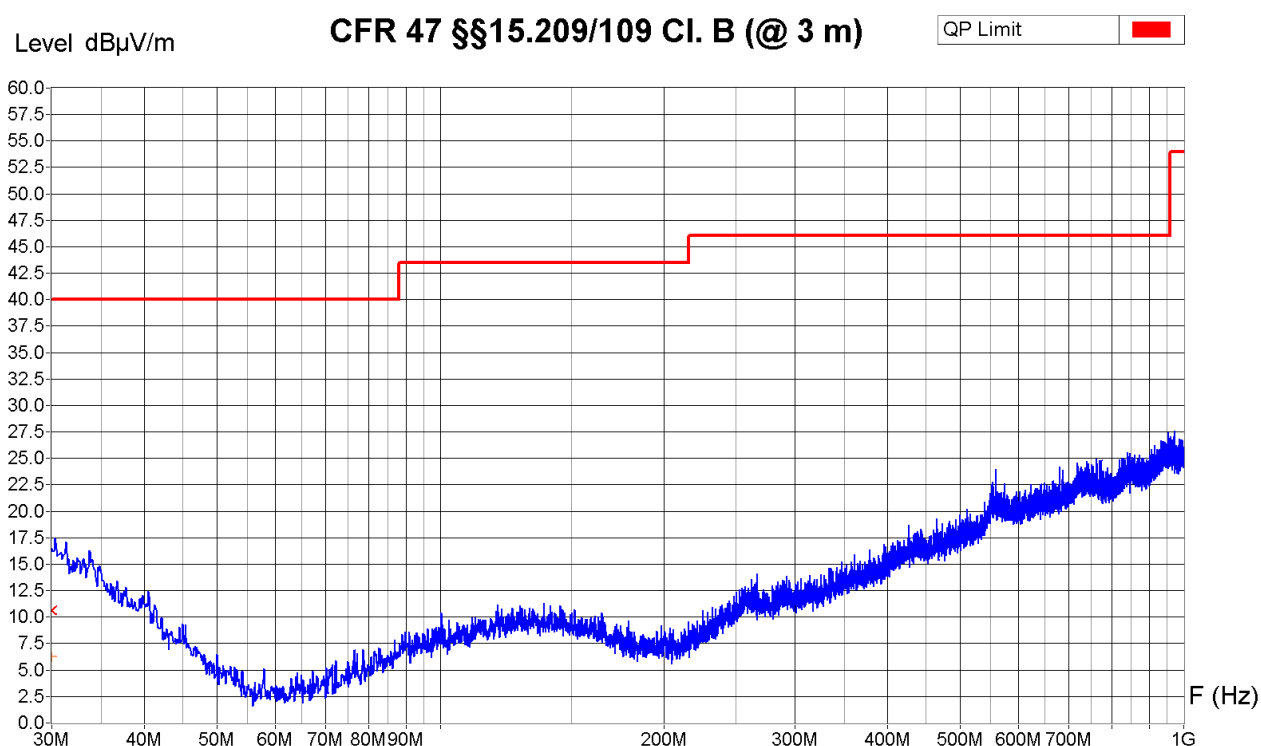
Spectrum analyzer	☐ 88-14	☐ 94-24	☐ 02-06	☐ 03-45	☐ 05-39	☒ 16-03
Receiver	☐ 85-04	☐ 90-43	☐ 94-35	☐ 04-29	☒ 16-03	
Preamplifier	☐ 90-01	☐ 95-86	☐ 05-56	☐ 05-59	☒ 16-03 internal	
Antenna (bilog)	☐ 94-03	☒ 05-38				
Cable set	☒ SAC3_RE_1.0/2.0/3.0	☐ 06-00C				
Software and Revision	☒ Vitam, Rev. 2.4.13	☐ RadiMation 2015.1.7				

Result: ☒ pass ☐ fail ☐ not applicable ☐ not tested

Measurement Type : Radiated Field
 Polarisation : Vertical
 Table Angle : 0 - 360°
 Antenna Height : 1 - 4m



Equipment Under Test : MODsense T2 DUT-10/B
 Set-Up : EUT standing on table (h = 0.8 m). See photos
 Operating Conditions : RX mode
 Remarks : I2C active



Zone	30 MHz - 1 GHz
Video Bandwidth	500 KHz
Resol Bandwidth	120 KHz

Receiver Measures

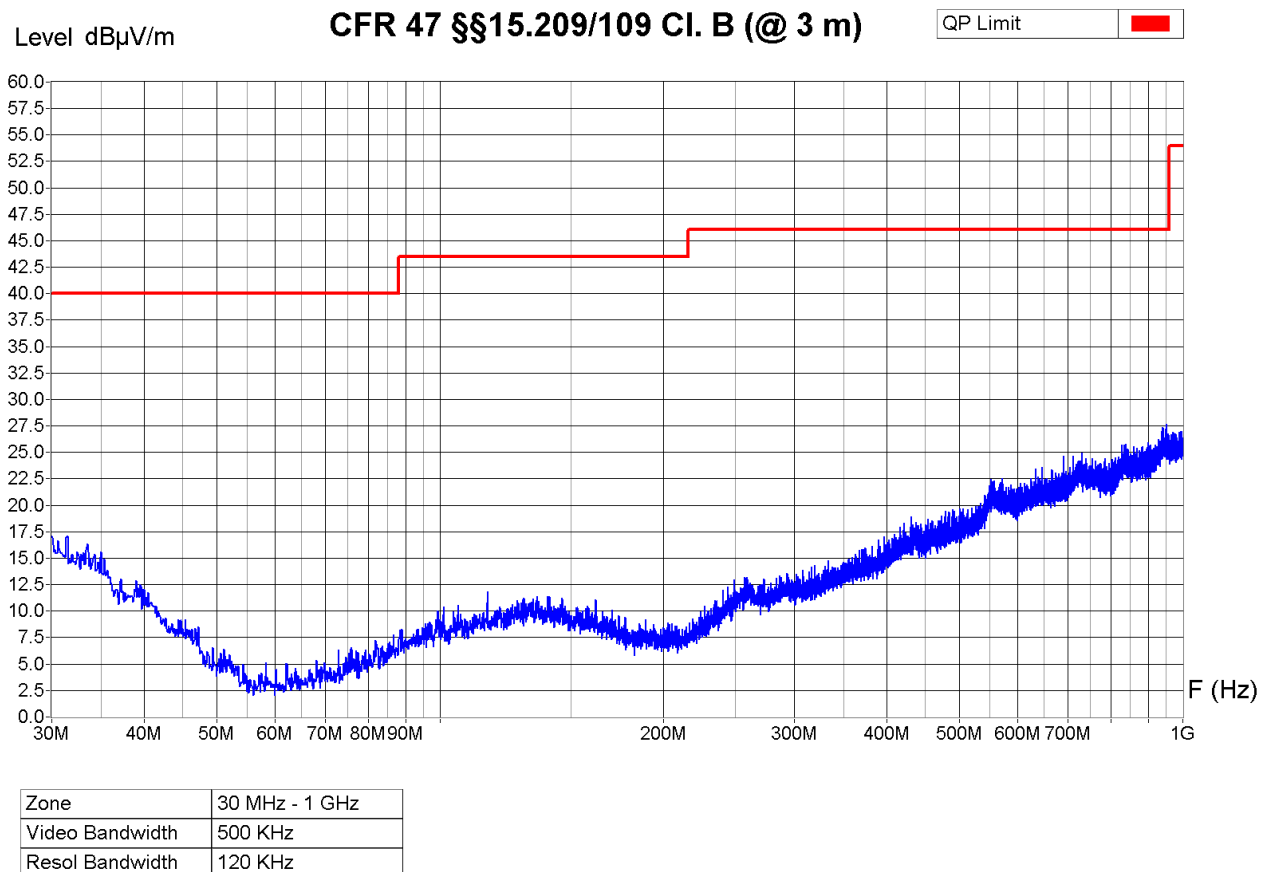
Frequency	Peak	QuasiPeak (x)	Average (+)	QP Margin
30 MHz	19.4 dBμV/m	10.6 dBμV/m	6.3 dBμV/m	29.4 dB

Operator: B. Itzcovich
 Date/Time: 20.10.2020 10:15
 Filename:
 21_RE_30M-1G_RX+
 I2C_FCC_V.png/.txt

Measurement Type : Radiated Field
Polarisation : Horizontal
Table Angle : 0 - 360°
Antenna Height : 1 - 4m



Equipment Under Test : MODsense T2 DUT-10/B
Set-Up : EUT standing on table (h = 0.8 m). See photos
Operating Conditions : RX mode
Remarks : I2C active



Operator: B. Itzcovich
Date/Time: 20.10.2020 10:35
Filename:
22_RE_30M-1G_RX+
I2C_FCC_H.png/.txt

6.9.2 1 GHz to 13 GHzTest site: ☐ SAC10 ☒ SAC3Distance: ☒ 1 m ☐ 3 m ☐ 10 m ☐ 30 m

Position of EUT: 1.5 m (height of the equipment under test above floor)

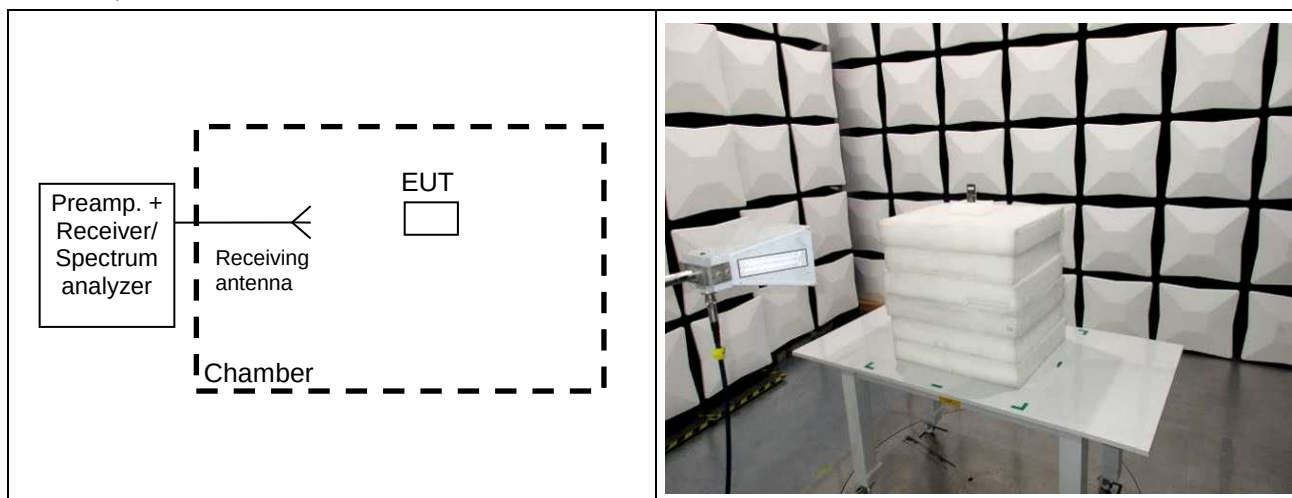
Meas. uncertainty: ± 4.7 dB

Test method: The electromagnetic disturbance radiated by the equipment is measured using a spectrum analyzer and a wide band antenna. The antenna is moved from 1 to 4 m in height successively with horizontal and vertical polarizations, and aimed at the source by tilting. The turning table is operated through 360° during the measurements. The recordings are carried out taking into account the maximum value (peak) of all the disturbances appearing while the apparatus is under test.

Modifications: ☒ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Climatic conditions: Temperature: 22 – 25 °C Humidity: 35 – 50 % Pressure QFE: 930 – 940 hPa

Test set-up:



Remarks: Limit values expressed in dB μ V/m and transformed to a measuring distance of 1m (factor used = 20 dB/decade) if necessary
e.g.: for f = 1 GHz the limit is 500 μ V/m at 3 m;

$$20\log\left(\frac{500\frac{\mu V}{m}}{1\frac{\mu V}{m}}\right) + 20\log\left(\frac{3m}{1m}\right) = 635\frac{dB\mu V}{m} \text{ at } 1m$$

Test equipment:

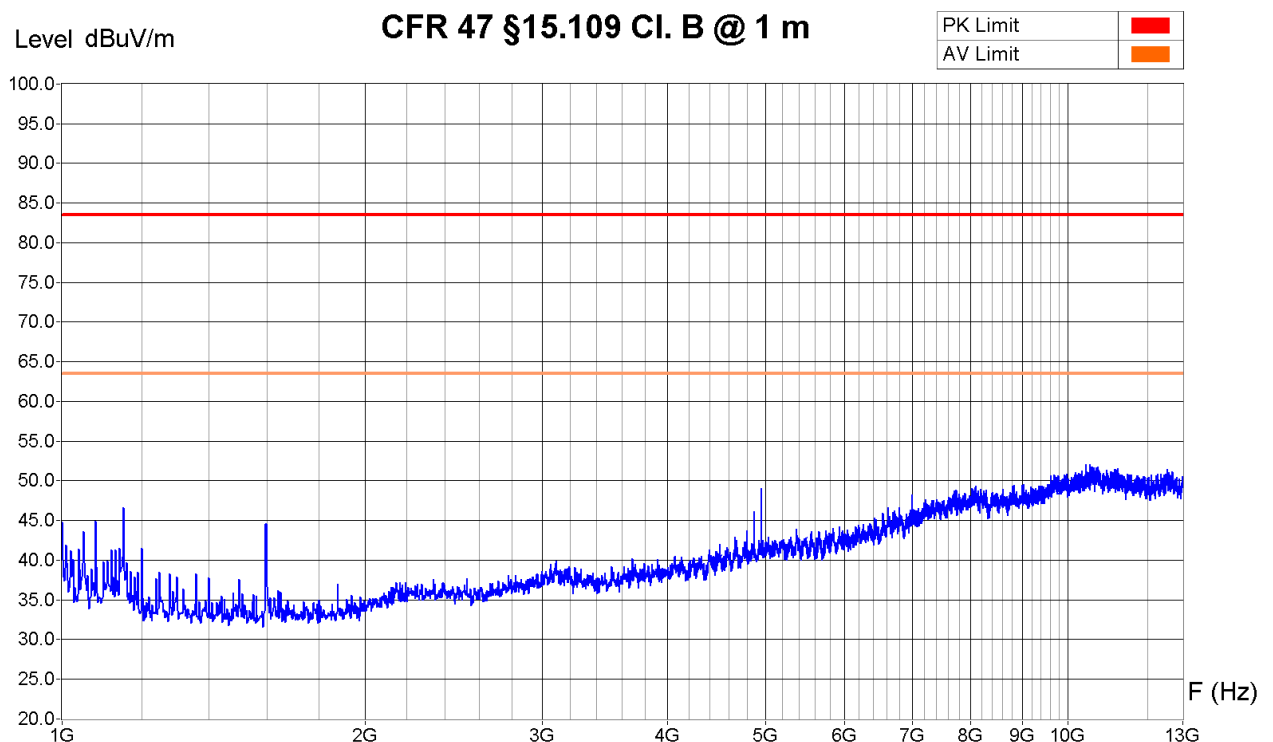
Spectrum analyzer	☐ 88-14	☐ 94-24	☐ 02-06	☐ 03-45	☐ 05-39	☒ 16-03
Receiver	☐ 85-04	☐ 90-43	☐ 94-35	☒ 16-03		
Preamplifier	☐ 90-01	☐ 95-86	☐ 05-56	☐ 05-59	☐ 05-62	
Antenna (type: magnetic)	☒ 90-25	☐ 90-28	☐ 99-32	☐ 04-79		
Cable set	☒ SAC3_RE_1.0/2.0/3.0		☐ 06-236			
Software and Revision	☒ Vitam, Rev. 2.4.13		☐ RadiMation 2015.1.7			
Spectrum analyzer	☐ 88-14	☐ 94-24	☐ 02-06	☐ 03-45	☐ 05-39	☒ 16-03

Result: ☒ pass ☐ fail ☐ not applicable ☐ not tested

Measurement Type : Radiated Field
Polarisation : Vertical
Table Angle : 0 - 360°
Antenna Height : 1 - 3m (tilted)



Equipment Under Test : MODsense T2 DUT-06/B
Set-Up : EUT standing on table (h = 1.5 m). See photos
Operating Conditions : RX mode, I2C not active
Remarks : Peak detector sweep, 3001 pts/zone



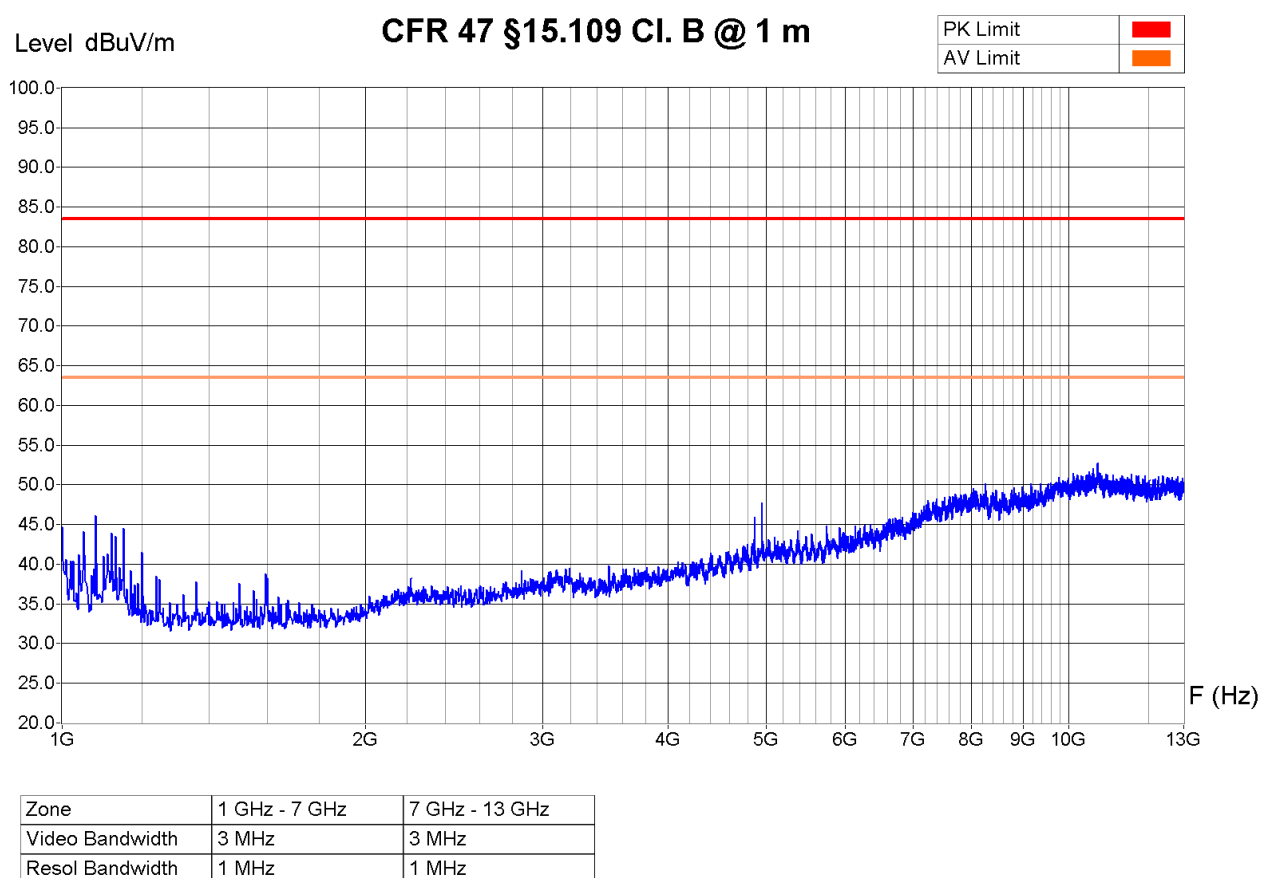
Zone	1 GHz - 7 GHz	7 GHz - 13 GHz
Video Bandwidth	3 MHz	3 MHz
Resol Bandwidth	1 MHz	1 MHz

Operator: B. Itzcovich
Date/Time: 01.09.2020 13:48
Filename:
07_RE_1-13G_RX_FCC_V.png/
.txt

Measurement Type : Radiated Field
 Polarisation : Horizontal
 Table Angle : 0 - 360°
 Antenna Height : 1 - 3m (tilted)



Equipment Under Test : MODsense T2 DUT-06/B
 Set-Up : EUT standing on table (h = 1.5 m). See photos
 Operating Conditions : RX mode, I2C not active
 Remarks : Peak detector sweep, 3001 pts/zone



Operator: B. Itzcovich
 Date/Time: 01.09.2020 13:57
 Filename:
 08_RE_1-13G_RX_FCC_H.png/
 .txt

6.10 Designation of emission

Standard: United States: 47 CFR "Code of Federal Regulations" – Telecommunication
☒ FCC Part 2, Subpart C: Emission: §2.201 and §2.202

Introduction: A system of designating emission, modulation and transmission characteristics shall be employed.

(a) Emissions are designated according to their classification and their necessary bandwidth.

(b) A minimum of three symbols are used to describe the basic characteristics of radio waves.

(c) Four symbols are used to describe the necessary bandwidth.

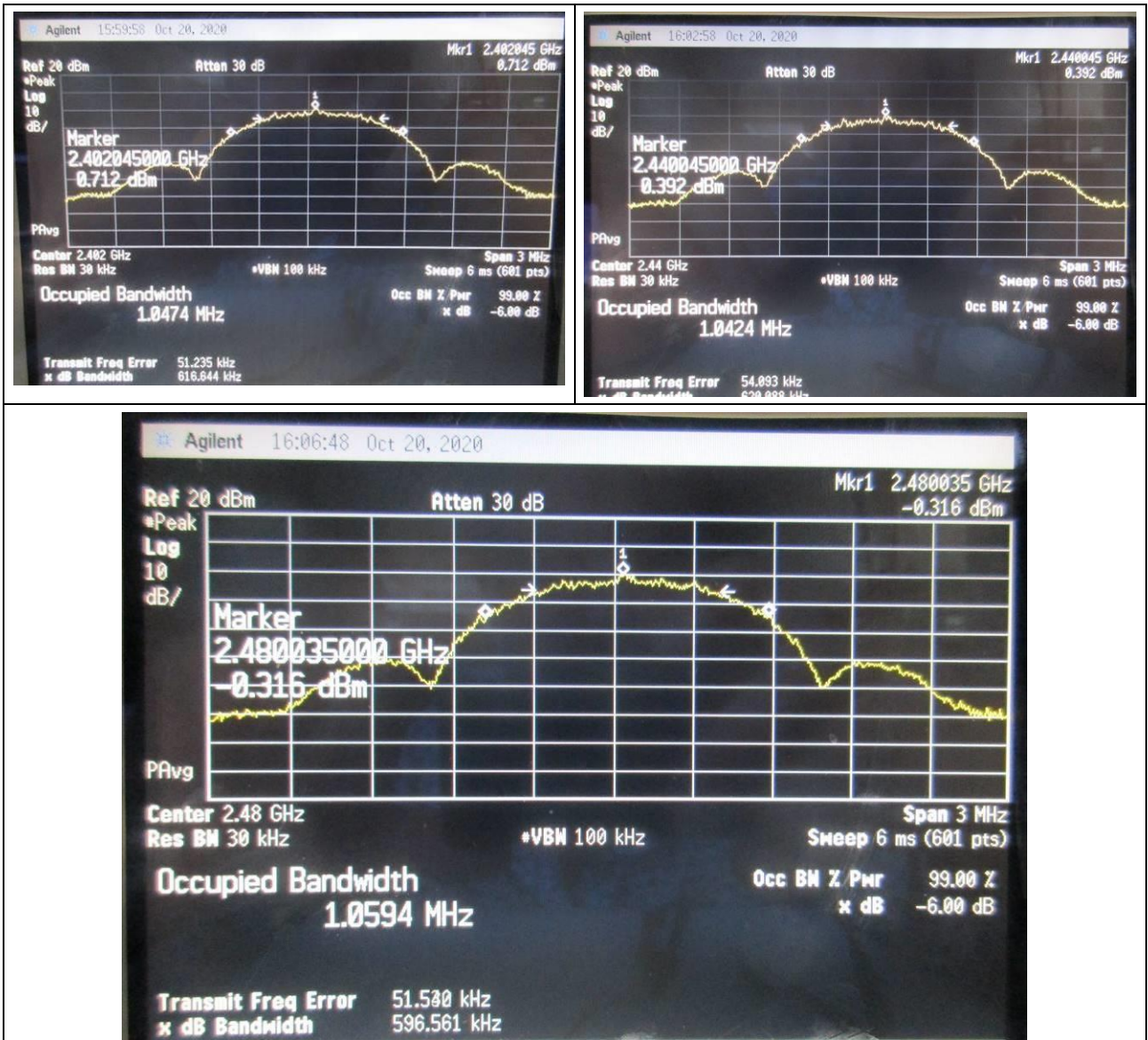
Modifications: ☒ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Necessary bandwidth: For a given class of emission, the minimum value of the occupied bandwidth sufficient to ensure the transmission of information at the rate and with the quality required for the system employed, under specified conditions.

$B_n = 1.059 \text{ MHz}$ (occupied bandwidth)

Basic characteristics: FXD F : frequency modulation
 X : Cases not otherwise covered
 D : data transmission

Designation of emission: 1M06FXD



Place and date of test:
 Operator:

Rossens, 2020-10-20
 B. Itzcovich

7. Appendix

7.1 Test equipment

Inventory No.	Designation	Manufacturer	Type	Cal. date	Next calibr.	Cal. period [year]
90-25	Loop antenna	Chase	HLA6120	2017-06-02	2021-06-02	4
05-38	Bi-Log antenna	Chase	CBL6111C	2018-11-01	2020-11-01	2
07-31	Horn antenna	Schwarzbeck	BBHA 9120 D	2018-10-09	2021-10-09	3
98-12	Horn Antenna + Preamp + Mixer	Emco + Miteq + Hewlett Packard	3160-09 + JDM2W-18002650- 27-10P-R + 11970K	2017-06-01	2021-06-01	4
00-52	Dipole antenna	Schwarzbeck	UHA 9125 D	2017-05-11	2021-05-11	4
12-06	HP Filter	BSC	SH 6472	2020-09-24	2022-09-24	2
13-14	Filter	A-INFOMW	Cavity Band Reject Filter	2020-09-23	2022-09-23	2
14-27	Preamplifier	Montena EMC	AFS42-00101800-25-S- 42	2020-01-08	2022-01-08	2
13-16	Signal Generator	AnaPico AG	APSIN20G-HC	2020-09-23	2022-09-23	2
06-00C	Cable	Huber&Suhner	SF106PA 600mm	2020-09-25	2023-09-25	3
SAC3_RE_1.0/2.0/3.0	Cable set	Huber&Suhner	SF104A	2019-09-30	2021-09-30	2
11-30	Cable	Huber&Suhner	ST18A 3m	2020-09-25	2022-09-25	2
10-51	Cable	Huber&Suhner	SF104	2020-02-06	2022-02-06	2
10-81	Cable	Huber&Suhner	SF104P	2017-06-01	2021-06-01	4
11-62	Cable	Huber&Suhner	SF104P	2017-06-01	2021-06-01	4
02-06	Spectr. Analyzer	Hewlett Packard	E4407B	2019-01-22	2021-01-22	2
16-03	Receiver + Spectr. Analyzer	Rohde& Schwarz	ESR7 1316.3003K07	2019-10-25	2021-10-25	2
09-04	Power sensor	Agilent	E9304A H19	2020-01-06	2022-01-06	2
05-73	Wattmeter	HP	E4418B	2020-09-25	2022-09-25	2
09-11	Multimeter	Fluke	87V	2019-07-08	2021-07-08	2
06-62	Power supply	Elektro-Automatik	EA-PS 2016-050	NO CAL	NO CAL	-
99-07	Power supply	Coutant	LA200.2	---	---	-

Remark: The test equipment for which no calibration date is defined, is controlled during the test by another calibrated equipment.
E.g. the output of a power supply with variable transformer is verified by a calibrated multimeter.