

Annex 1: Measurement diagrams 19-1-0173601T06a-A1-C1

Number of pages:	30	Date of Report:	2021-Jan-21
Testing company:	CETECOM GmbH Im Teelbruch 116 45219 Essen Germany Tel. + 49 (0) 20 54 / 95 19-0 Fax: + 49 (0) 20 54 / 95 19-150	Applicant:	Continental Advanced Antenna GmbH
Test Object / Tested Device(s):	RKE-Transceiver , RKE232E1		
FCC ID:	2ACC7RKE232E1	IC:	11980A-RKE232E1
Testing has been carried out in accordance with:	FCC Regulations: Title 47, Subpart 15.231 ISED Regulations: RSS-Gen, Issue 5; RSS-210, Issue 10 Deviations, modifications or clarifications (if any) to above mentioned documents are written in each section under "Test method and limit".		



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1 Measurement diagrams

1.1 Fundamental field strength (15.231(b))

1.1.1 Measurements on antenna 1, ch1

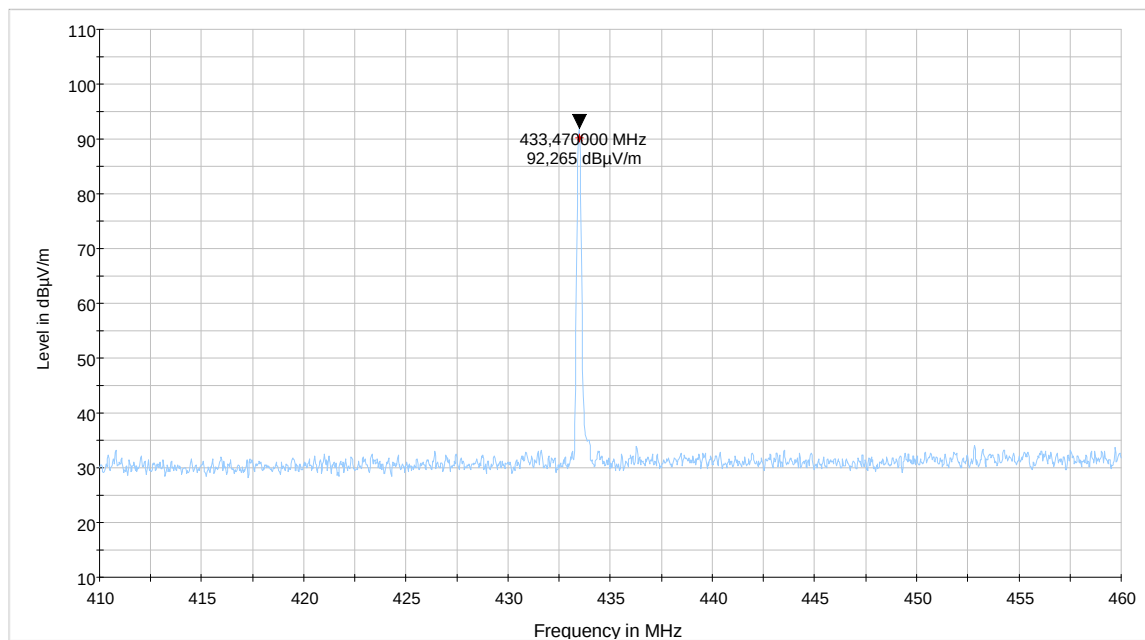
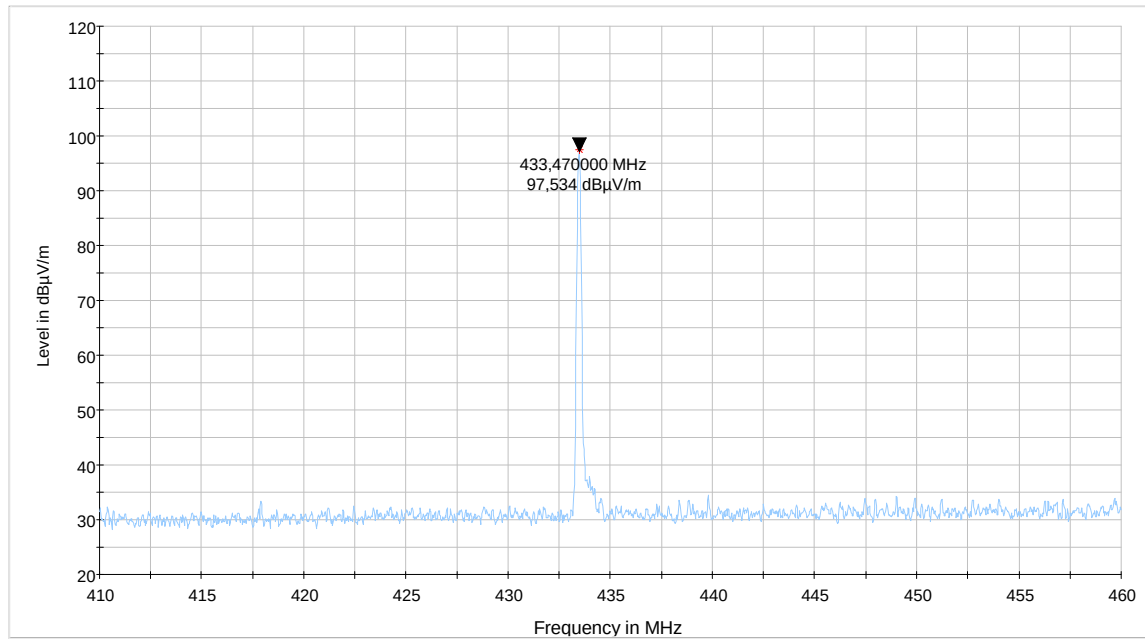


Diagram 3.03b: EUT at lying position (see limit in the main test report)

AV-Value: 92.27 – 17.33 dB (Timing) = 74.94 dBµV/m@3m

1.1.2 Measurements on antenna 2, ch3

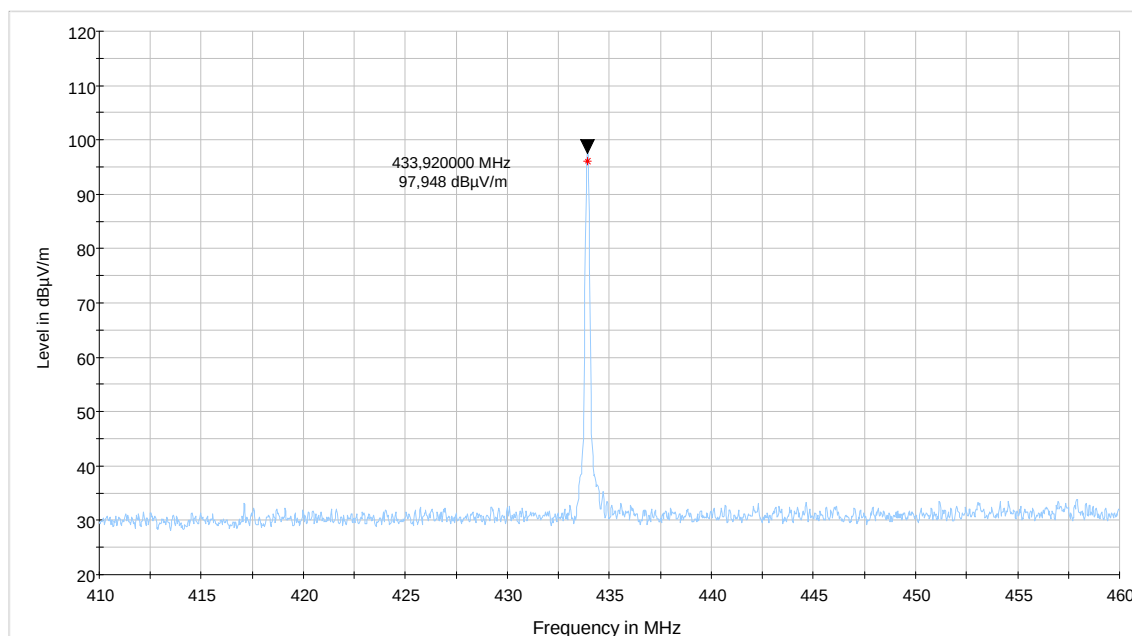


Diagram 3.04b: EUT at standing position (see limit in the main test report)

AV-Value: $97.95 - 17.33 \text{ dB (Timing)} = 80.62 \text{ dBμV/m@3m}$

1.2 Radiated magnetic field strength measurements (f < 30 MHz)

1.2.1 Measurements on antenna 1, ch1

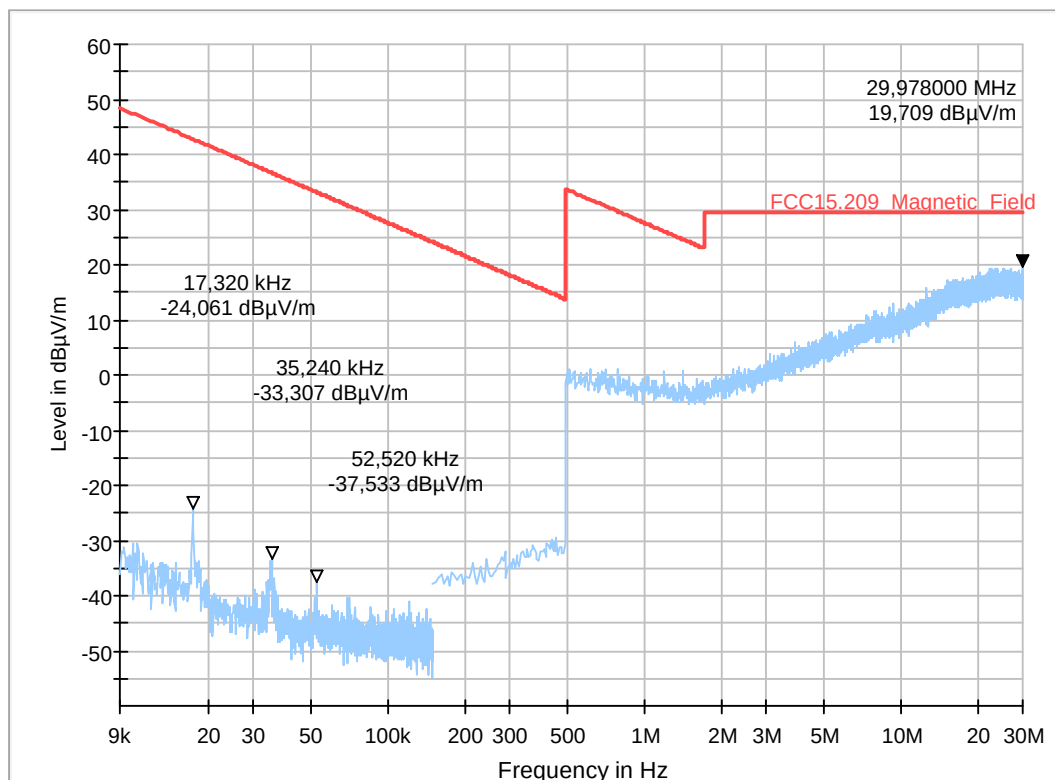
2.01_RSE_TX_Ch1_RF-Port1_EUT_standing

Common Information

Test description:	Magnetic Field Strength Measurement related to 30/300 m distance
Test site and distance:	Ref.-Nr. 441 Semi Anechoic Room (SAR) with 3 m measurement distance
Version of Testsoftware:	EMC32 V9.25.0
Distance correction:	used accord. table, pls. see test report
Used filter:	bypass
Test specification:	FCC 15.209/RSS-Gen, Issue 5

Operator:	GHu
Environmental Conditions:	Humidity : 68%rH; Temperature: 21°C
EUT:	19-1-01736S15_C01
Operating Mode:	CW ch1 port1
Power during tests:	12 V DC
EUT Setup:	Standing
Verdict:	Passed

Full Spectrum

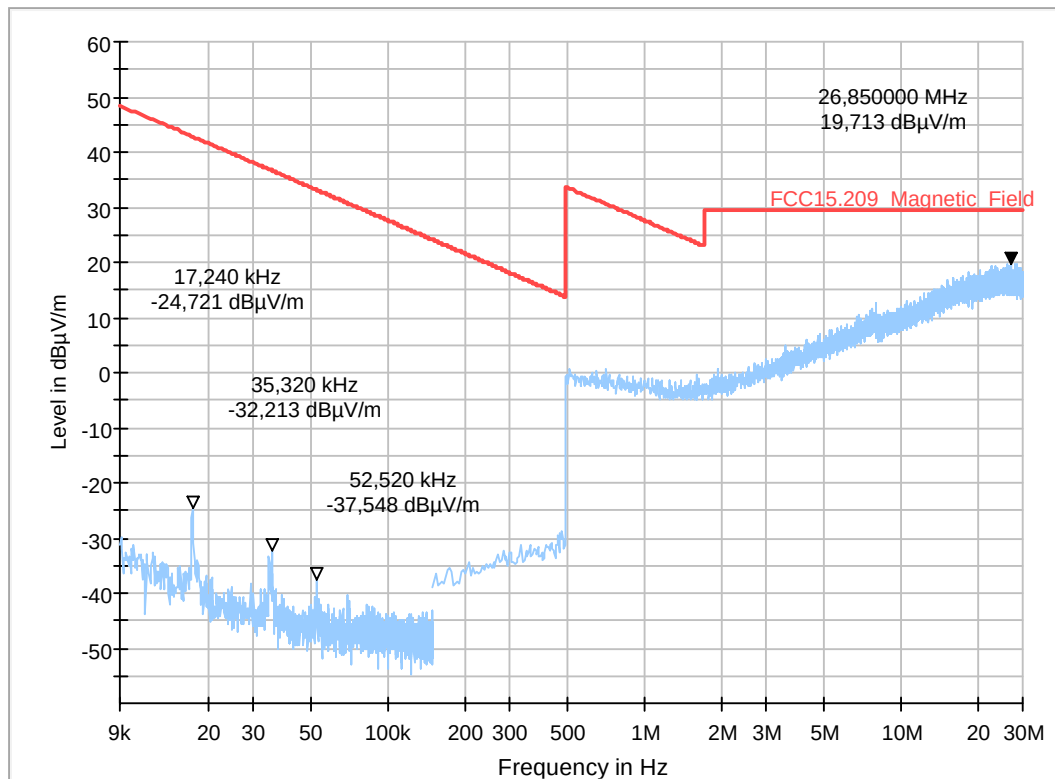


2.02_RSE_TX_Ch1_RF-Port1_EUT_lying

Common Information

Test description:	Magnetic Field Strength Measurement related to 30/300 m distance
Test site and distance:	Ref.-Nr. 441 Semi Anechoic Room (SAR) with 3 m measurement distance
Version of Testsoftware:	EMC32 V9.25.0
Distance correction:	used accord. table, pls. see test report
Used filter:	bypass
Test specification:	FCC 15.209/RSS-Gen, Issue 5
Operator:	GHu
Environmental Conditions:	Humidity : 68%rH; Temperature: 21°C
EUT:	19-1-01736S15_C01
Operating Mode:	CW ch1 port1
Power during tests:	12 V DC
EUT Setup:	lying
Verdict:	Passed

Full Spectrum



1.2.2 Measurements on antenna 2, ch2

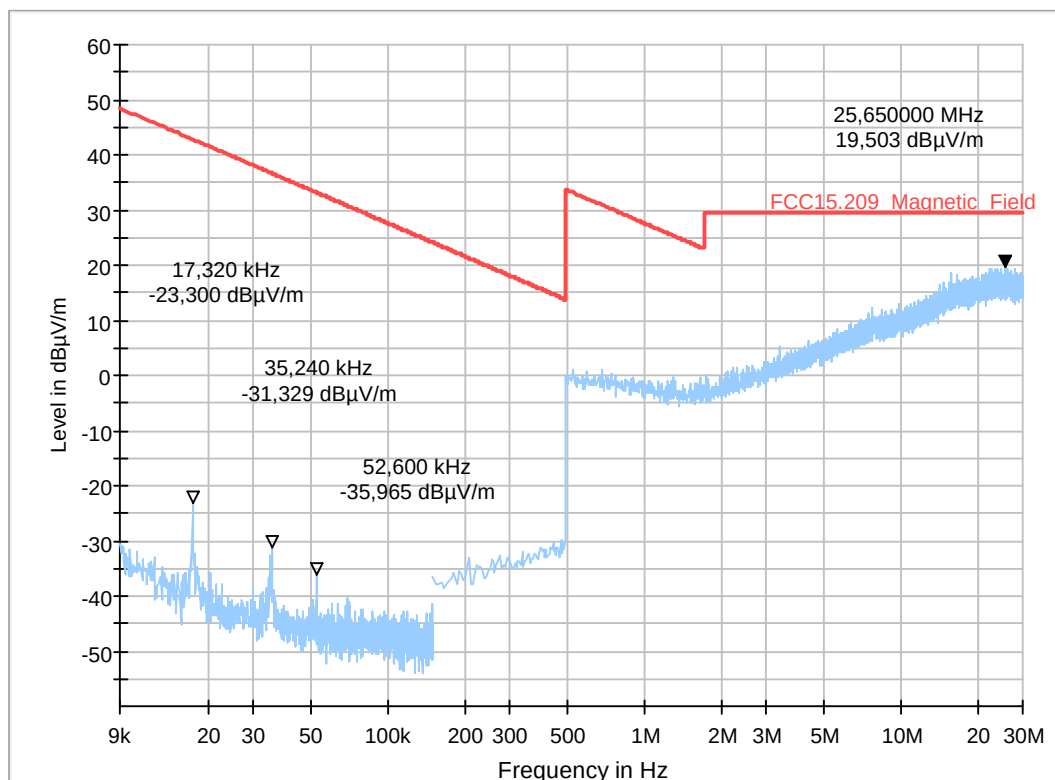
2.03_RSE_RX_Ch2_RF-Port2_EUT_lying

Common Information

Test description:	Magnetic Field Strength Measurement related to 30/300 m distance
Test site and distance:	Ref.-Nr. 441 Semi Anechoic Room (SAR) with 3 m measurement distance
Version of Testsoftware:	EMC32 V9.25.0
Distance correction:	used accord. table, pls. see test report
Used filter:	bypass
Test specification:	FCC 15.209/RSS-Gen, Issue 5

Operator:	GHu
Environmental Conditions:	Humidity : 68%rH; Temperature: 21°C
EUT:	19-1-01736S18_C01
Operating Mode:	Receiving mode ch2 port2
Power during tests:	12 V DC
EUT Setup:	lying
Verdict:	Passed

Full Spectrum



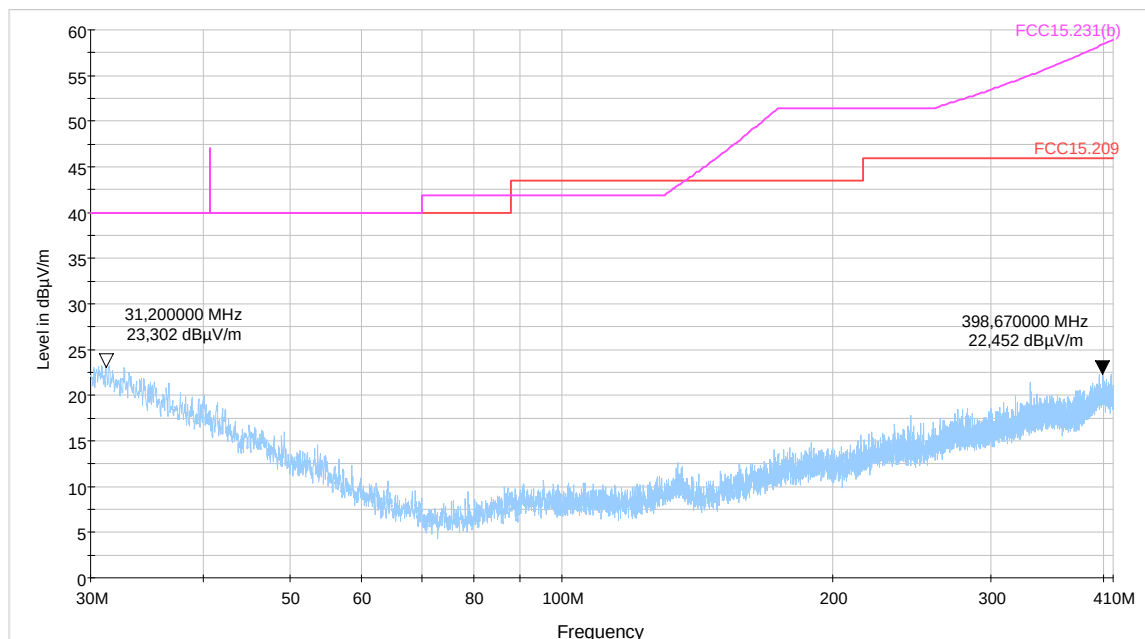
1.3 Radiated emissions in the frequency range 30 to 1000 MHz

1.3.1 Measurements on antenna 1, ch1

3.01a_RSE_TX_Ant1Ch1_EUT_standing

Common Information

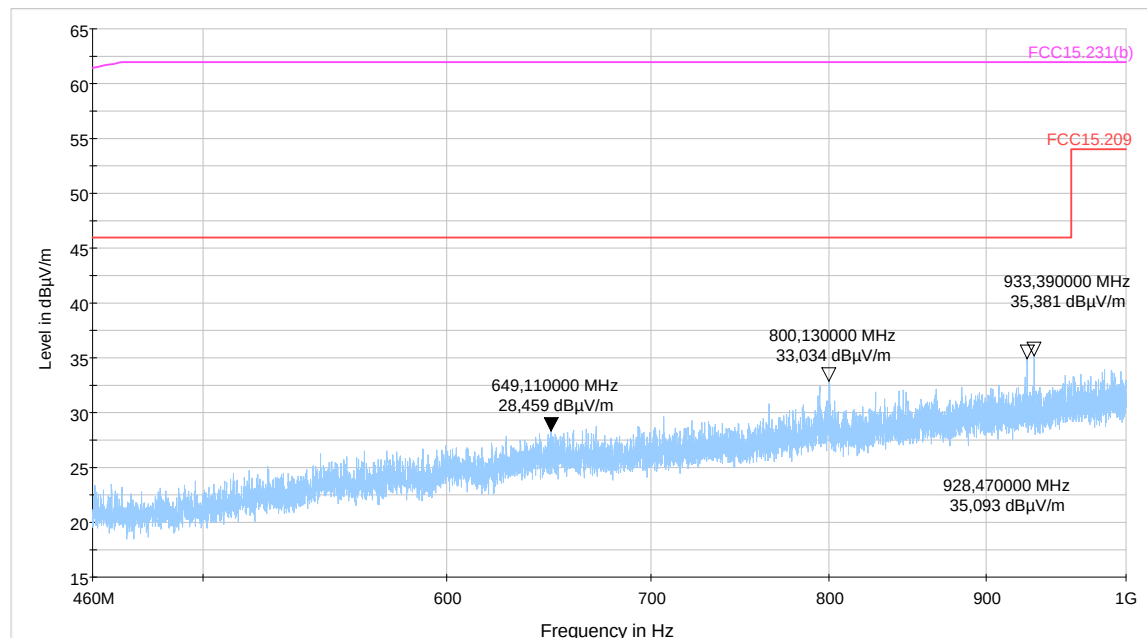
Test description:	Electric Field Strength Measurement
Test site and distance:	Ref.-Nr. 441 Semi Anechoic Room (SAR) with 3 m measurement distance
Version of Testsoftware:	EMC32 V9.25.0
Distance correction:	not used
Used filter:	not used
Test specification.:	FCC §15.209/§15.231 / RSS-210, Issue9, B.6 / RSS-Gen, Issue 5
Operator:	HLa
Environmental Conditions.:	Humidity : 68%rH; Temperature: 21°C
EUT:	19-1-01736S15_C01
Operating Mode:	TX ch1 port1
Power during tests:	12 V DC
EUT Setup:	standing
Verdict:	Passed
Comment:	The measurement at 433 MHz (carrier) is left out to avoid overload on the test receiver.



3.01c_RSE_TX_Ant1Ch1_EUT_standing

Common Information

Test description:	Electric Field Strength Measurement
Test site and distance:	Ref.-Nr. 441 Semi Anechoic Room (SAR) with 3 m measurement distance
Version of Testsoftware:	EMC32 V9.25.0
Distance correction:	not used
Used filter:	not used
Test specification.:	FCC §15.209/§15.231 / RSS-210, Issue9, B.6 / RSS-Gen, Issue 5
Operator:	HLa
Environmental Conditions.:	Humidity : 68%rH; Temperature: 21°C
EUT:	19-1-01736S15_C01
Operating Mode:	TX ch1 port1
Power during tests:	12 V DC
EUT Setup:	standing
Verdict:	Passed
Comment:	The measurement at 433 MHz (carrier) is left out to avoid overload on the test receiver.

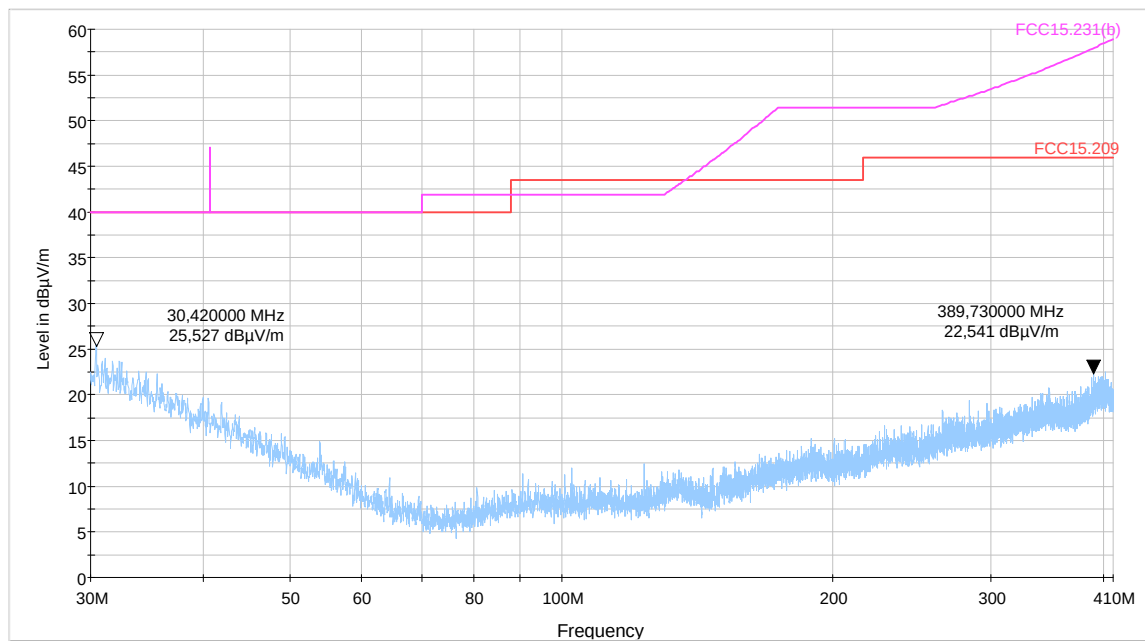


Remark: The marked emissions at 800 MHz, 928 MHz and 933 MHz are external, which are irrelevant to the limit.

3.03a_RSE_TX_Ant1Ch1_EUT_lying

Common Information

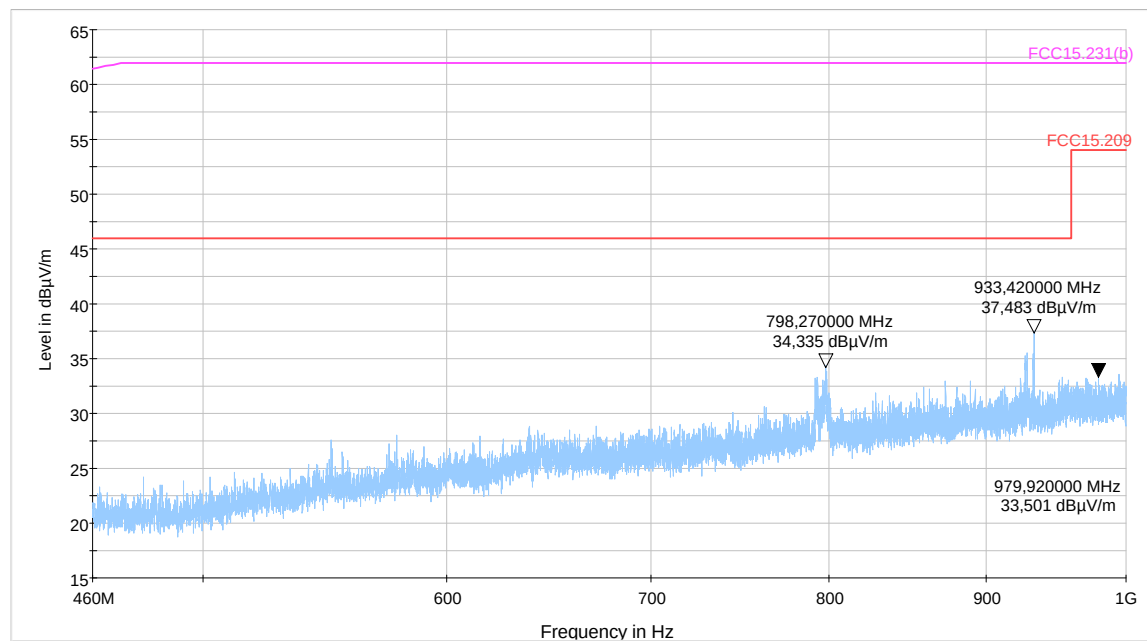
Test description:	Electric Field Strength Measurement
Test site and distance:	Ref.-Nr. 441 Semi Anechoic Room (SAR) with 3 m measurement distance
Version of Testsoftware:	EMC32 V9.25.0
Distance correction:	not used
Used filter:	not used
Test specification.:	FCC §15.209/§15.231 / RSS-210, Issue9, B.6 / RSS-Gen, Issue 5
Operator:	TFr
Environmental Conditions.:	Humidity : 68%rH; Temperature: 21°C
EUT:	19-1-01736S15_C01
Operating Mode:	TX ch1 port1
Power during tests:	12 V DC
EUT Setup:	lying
Verdict:	Passed
Comment:	The measurement at 433 MHz (carrier) is left out to avoid overload on the test receiver.



3.03c_RSE_TX_Ant1Ch1_EUT_lying

Common Information

Test description:	Electric Field Strength Measurement
Test site and distance:	Ref.-Nr. 441 Semi Anechoic Room (SAR) with 3 m measurement distance
Version of Testsoftware:	EMC32 V9.25.0
Distance correction:	not used
Used filter:	not used
Test specification.:	FCC §15.209/§15.231 / RSS-210, Issue9, B.6 / RSS-Gen, Issue 5
Operator:	TFr
Environmental Conditions.:	Humidity : 68%rH; Temperature: 21°C
EUT:	19-1-01736S15_C01
Operating Mode:	TX ch1 port1
Power during tests:	12 V DC
EUT Setup:	lying
Verdict:	Passed
Comment:	The measurement at 433 MHz (carrier) is left out to avoid overload on the test receiver.



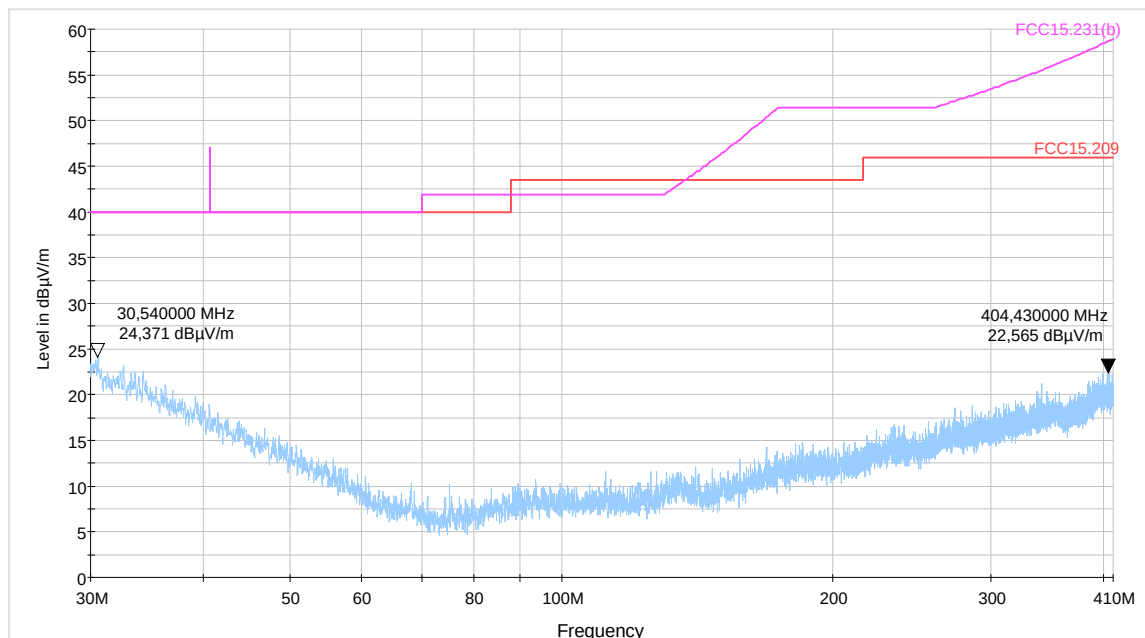
Remark: The marked emissions at 798 MHz and 933 MHz are external, which are irrelevant to the limit.

1.3.2 Measurements on antenna 2, ch3

3.02a_RSE_TX_Ant2Ch3_EUT_standing

Common Information

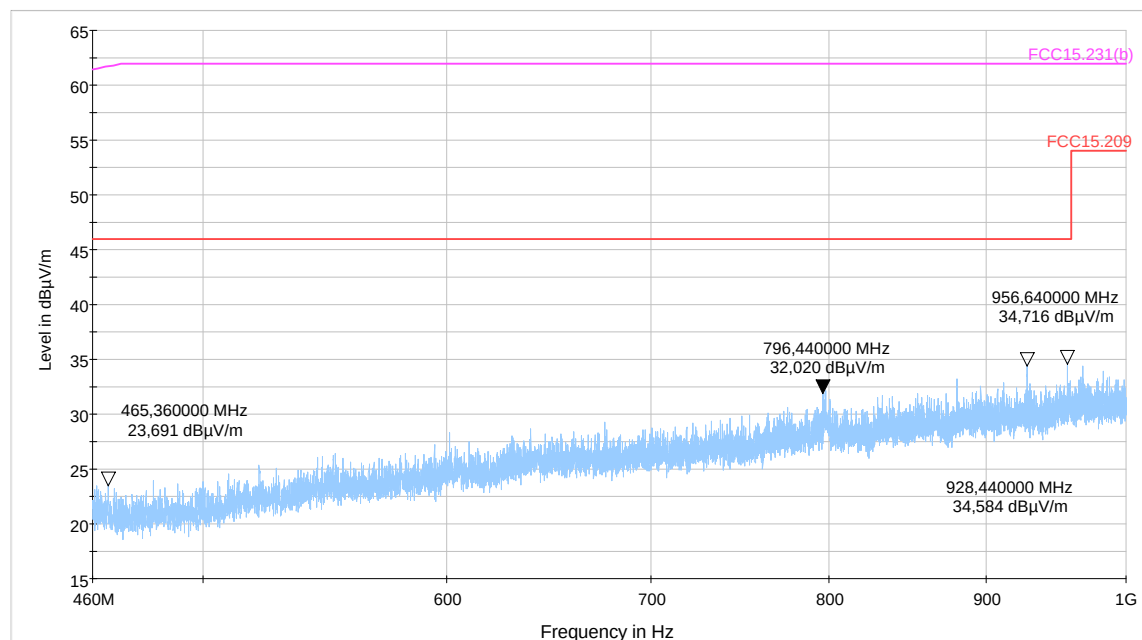
Test description:	Electric Field Strength Measurement
Test site and distance:	Ref.-Nr. 441 Semi Anechoic Room (SAR) with 3 m measurement distance
Version of Testsoftware:	EMC32 V9.25.0
Distance correction:	not used
Used filter:	not used
Test specification.:	FCC §15.209/§15.231 / RSS-210, Issue9, B.6 / RSS-Gen, Issue 5
Operator:	HLA
Environmental Conditions.:	Humidity : 68%rH; Temperature: 21°C
EUT:	19-1-01736S17_C01
Operating Mode:	TX ch3 port2
Power during tests:	12 V DC
EUT Setup:	standing
Verdict:	Passed
Comment:	The measurement at 433 MHz (carrier) is left out to avoid overload on the test receiver.



3.02c_RSE_TX_Ant2Ch3_EUT_standing

Common Information

Test description:	Electric Field Strength Measurement
Test site and distance:	Ref.-Nr. 441 Semi Anechoic Room (SAR) with 3 m measurement distance
Version of Testsoftware:	EMC32 V9.25.0
Distance correction:	not used
Used filter:	not used
Test specification.:	FCC §15.209/§15.231 / RSS-210, Issue9, B.6 / RSS-Gen, Issue 5
Operator:	HLa
Environmental Conditions.:	Humidity : 68%rH; Temperature: 21°C
EUT:	19-1-01736S17_C01
Operating Mode:	TX ch3 port2
Power during tests:	12 V DC
EUT Setup:	standing
Verdict:	Passed
Comment:	The measurement at 433 MHz (carrier) is left out to avoid overload on the test receiver.



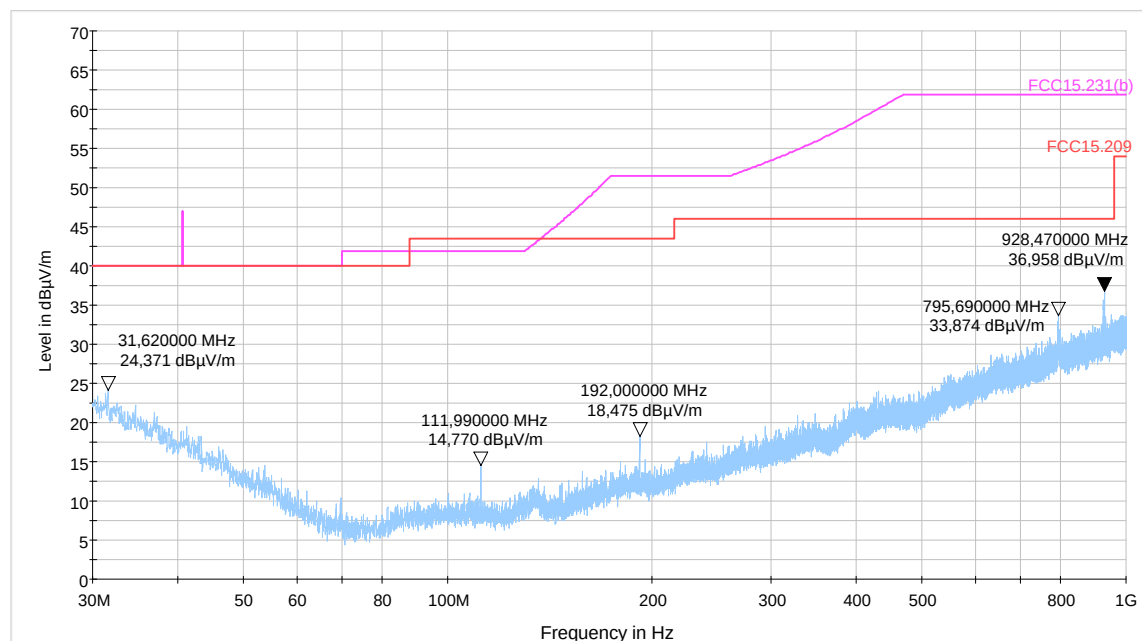
Remark: The marked emissions at 796 MHz and 928 MHz are external, which are irrelevant to the limit.

3.04_RSE_RX_Ant2Ch2_EUT_standing

Common Information

Test description:	Electric Field Strength Measurement
Test site and distance:	Ref.-Nr. 441 Semi Anechoic Room (SAR) with 3 m measurement distance
Version of Testsoftware:	EMC32 V9.25.0
Distance correction:	not used
Used filter:	not used
Test specification.:	FCC §15.209/§15.231 / RSS-210, Issue9, B.6 / RSS-Gen, Issue 5

Operator:	TFra
Environmental Conditions.:	Humidity : 68%rH; Temperature: 21°C
EUT:	19-1-01736S18_C01
Operating Mode:	RX ch2 port2
Power during tests:	12 V DC
EUT Setup:	standing
Verdict:	Passed



Remark: The marked emissions at 795 MHz and 928 MHz are external, which are irrelevant to the limit.

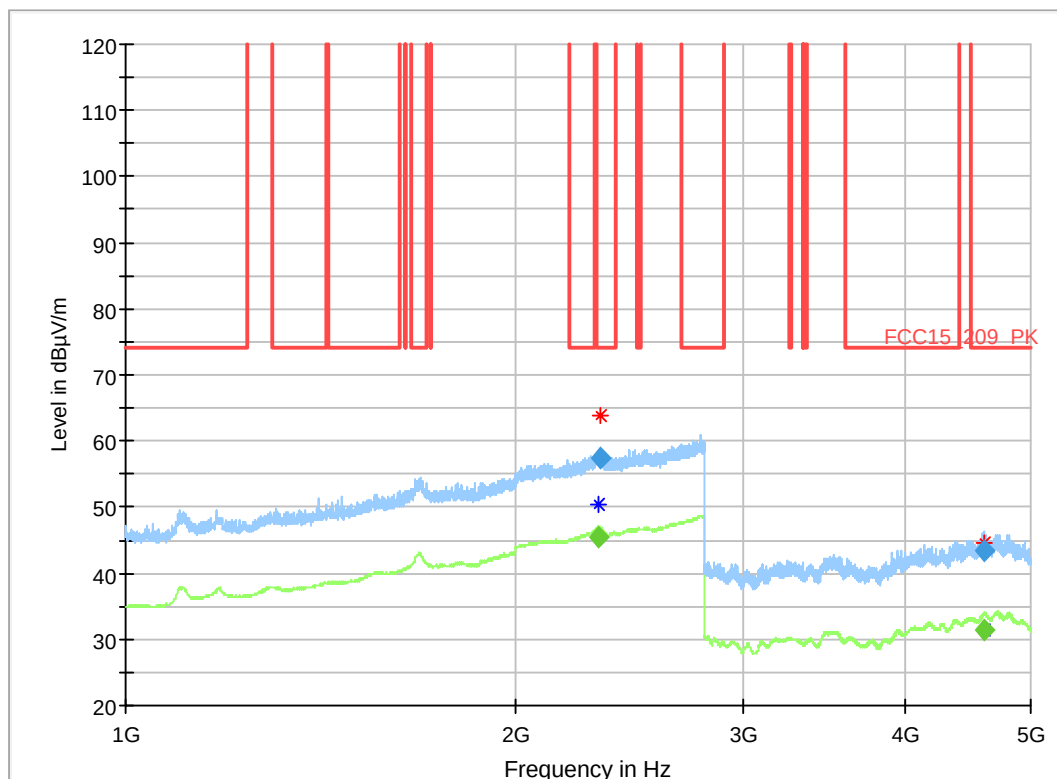
1.4 Radiated emissions in the frequency range above 1000MHz

4.02_RSE_TX_Ant1_Ch1_EUT_standing

Common Information

Test Description:	Radiated field strength emission in 3m distance
Test Site:	CETECOM GmbH Essen
Test Standard:	FCC 15.231
Antenna polarization:	horizontal/vertical
Test specification.:	FCC §15.209/§15.231 / RSS-210, Issue9, B.6 / RSS-Gen, Issue 5
Environmental Conditions.:	Humidity : 55% rH; Temperature: 21 °C
Operator:	TFra
EUT:	S15_C01
Operating Mode:	TX CW Ant1Ch1
EUT Setup:	EUT at standing position
Verdict:	Pass

Full Spectrum



Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB/m)
2321.200000	---	45.42	---	---	100.0	1000.000	155.0	H	221.0	0.0	37
2326.000000	57.35	---	74.00	16.65	100.0	1000.000	155.0	V	195.0	0.0	37
4599.600000	43.39	---	74.00	30.61	100.0	1000.000	155.0	H	36.0	0.0	5
4608.000000	---	31.29	---	---	100.0	1000.000	155.0	V	249.0	0.0	5

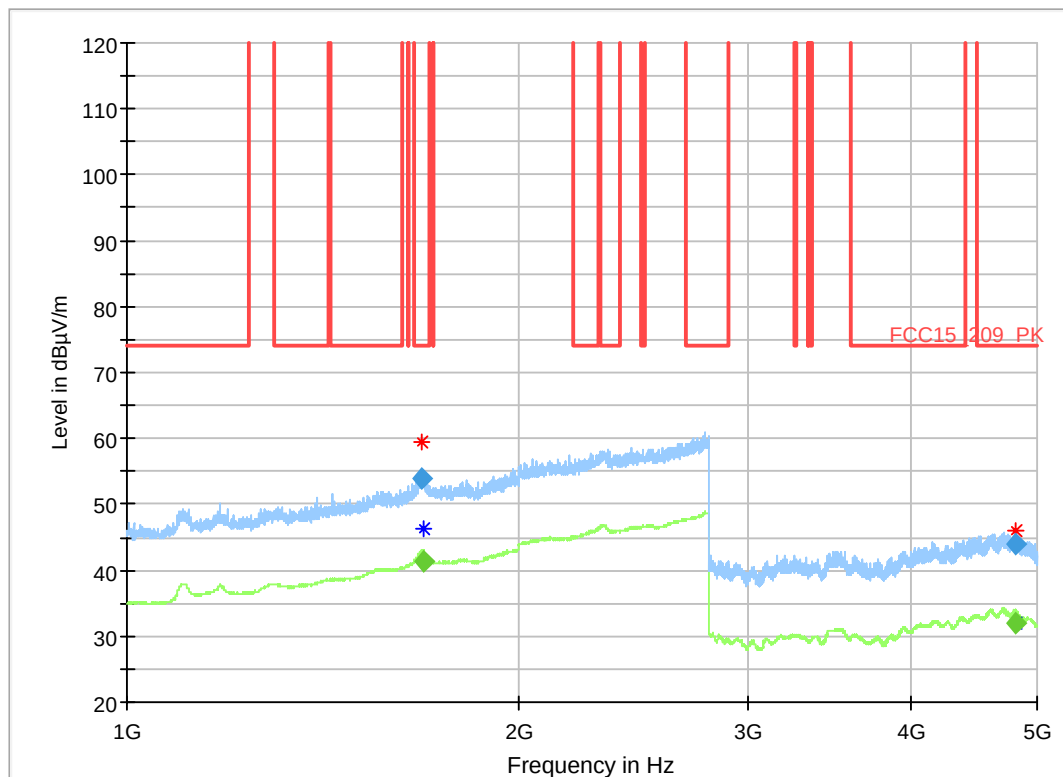
4.03_RSE_TX_Ant1_Ch1_EUT_lying

Common Information

Test Description: Radiated field strength emission in 3m distance
 Test Site: CETECOM GmbH Essen
 Test Standard: FCC 15.231
 Antenna polarization: horizontal/vertical
 Test specification.: FCC §15.209/§15.231 / RSS-210, Issue9, B.6 / RSS-Gen, Issue 5

Environmental Conditions.: Humidity : 55% rH; Temperature: 21 °C
 Operator: TFra
 EUT: S15_C01
 Operating Mode: TX CW Ant1Ch1
 EUT Setup: EUT at lying position
 Verdict: Pass

Full Spectrum



Final Result

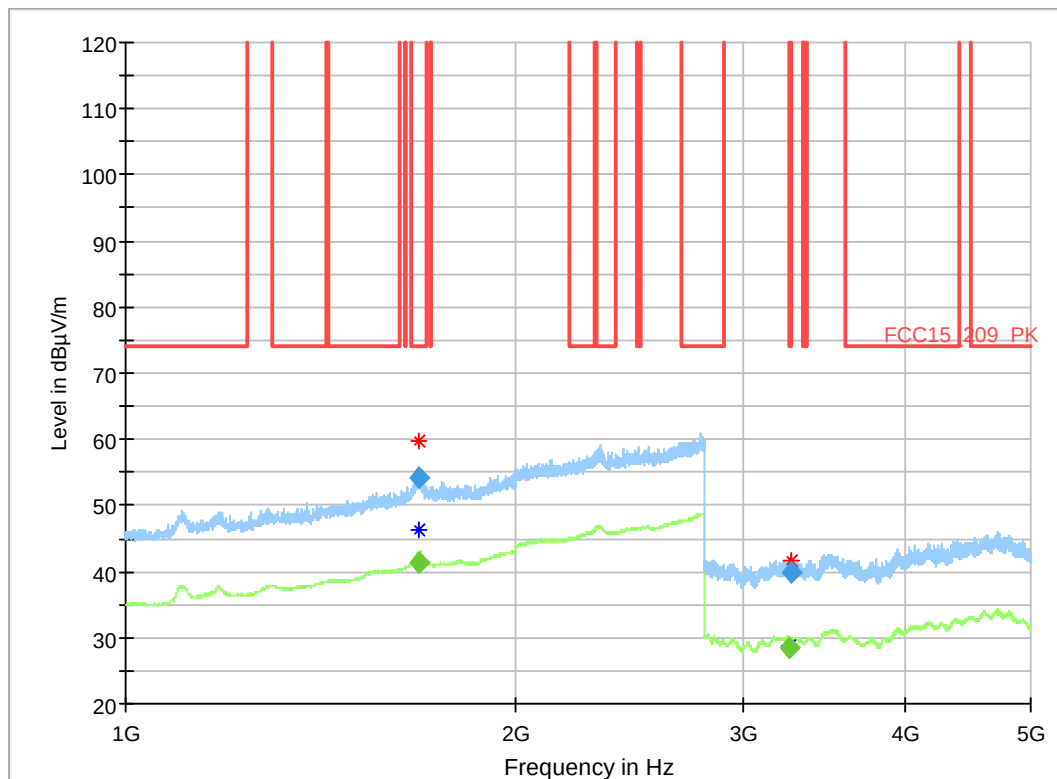
Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB/m)
1683.600000	53.85	---	74.00	20.15	100.0	1000.000	155.0	V	339.0	0.0	34
1690.400000	---	41.39	---	---	100.0	1000.000	155.0	V	36.0	0.0	34
4816.400000	---	32.08	---	---	100.0	1000.000	155.0	V	110.0	0.0	6
4819.200000	44.06	---	74.00	29.94	100.0	1000.000	155.0	H	135.0	0.0	6

4.01_RSE_RX_Ant1_Ch3_EUT_standing

Common Information

Test Description:	Radiated field strength emission in 3m distance
Test Site:	CETECOM GmbH Essen
Test Standard:	FCC 15.231
Antenna polarization:	horizontal/vertical
Test specification.:	FCC §15.209/§15.231 / RSS-210, Issue9, B.6 / RSS-Gen, Issue 5
Environmental Conditions.:	Humidity : 55% rH; Temperature: 21 °C
Operator:	TFra
EUT:	S15_C01
Operating Mode:	RX Ant1Ch3
EUT Setup:	EUT at standing position
Verdict:	Pass

Full Spectrum

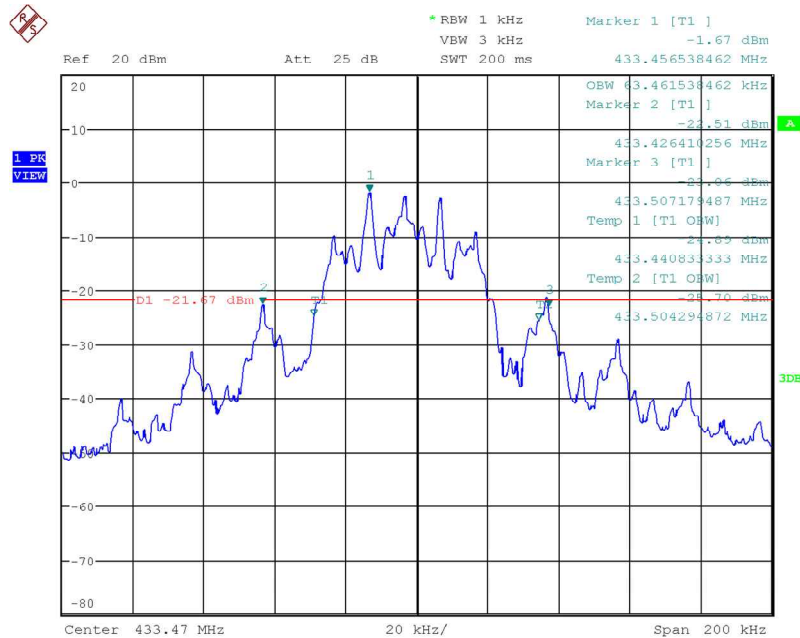


Final Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB/m)
1683.200000	54.09	---	74.00	19.91	100.0	1000.000	155.0	H	312.0	0.0	34
1684.800000	---	41.36	---	---	100.0	1000.000	155.0	V	276.0	0.0	34
3252.400000	---	28.61	---	---	100.0	1000.000	155.0	V	194.0	0.0	2
3263.200000	39.92	---	74.00	34.08	100.0	1000.000	155.0	H	304.0	0.0	2

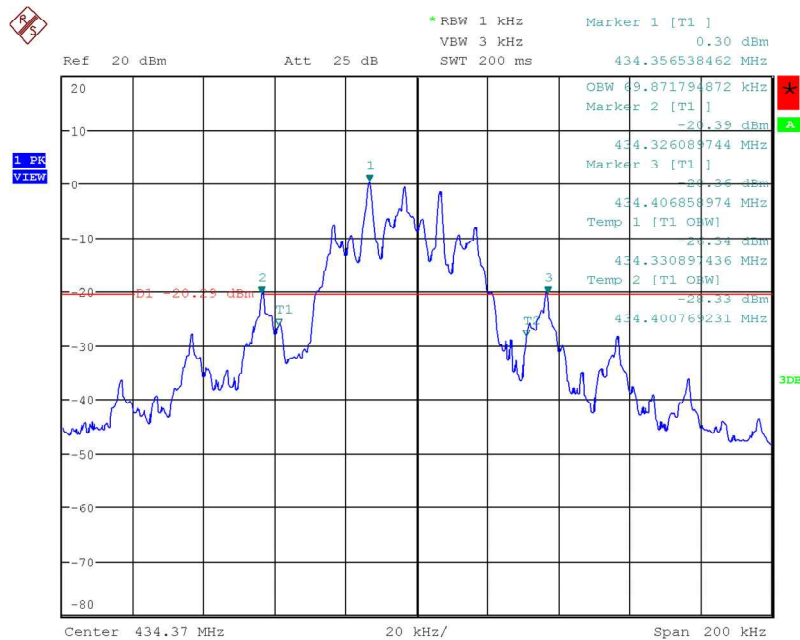
1.5 20dBc bandwidth & 99% occupied bandwidth

1.5.1 Measurements on antenna 1, ch1



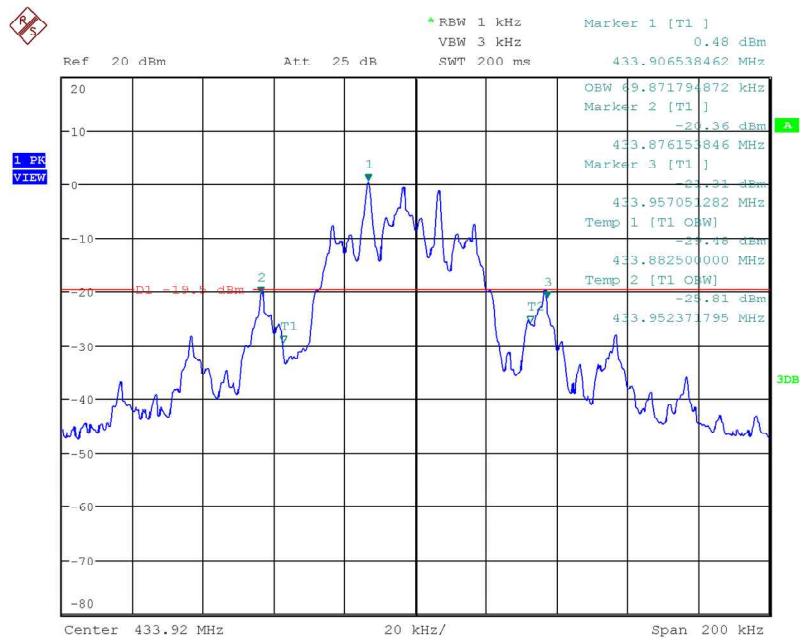
Date: 25.AUG.2020 13:11:52

1.5.2 Measurements on antenna 1, ch2



Date: 25.AUG.2020 13:15:54

1.5.3 Measurements on antenna 1, ch3



Date: 25.AUG.2020 13:20:26

1.6 Duty-Cycle correction

A duty-cycle Peak to AV applies since the transmitter is not 100% on during a 100 ms time unit. Pls. see below diagrams showing the behavior of the pulses and calculations performed

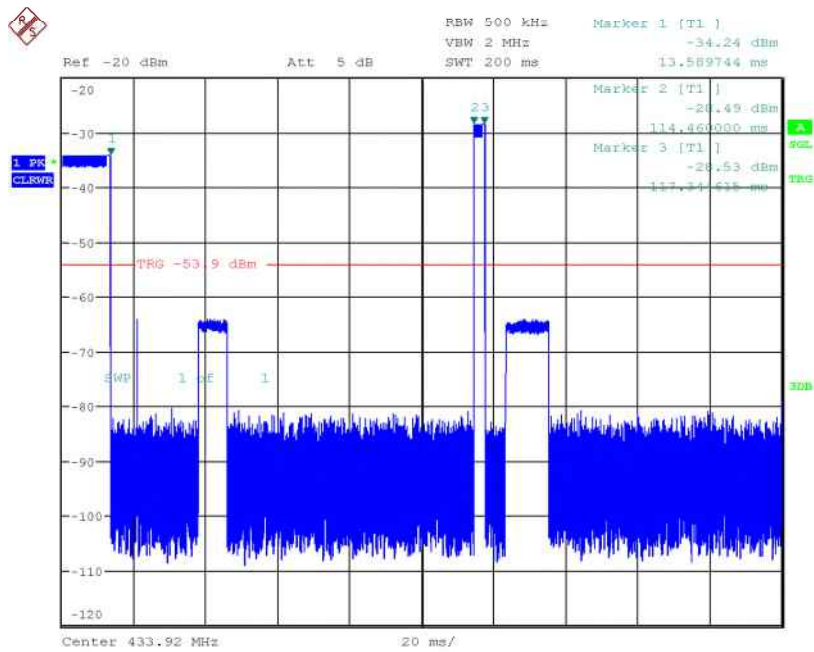
Worst-Case Duty-Cycle correction = -17.33 dB (Section 1.8.1.1)

1.7.1 Deactivation of transmitter (§15.231(a)(1))

1.7.1.1 Op.4: Engine start, key fob available



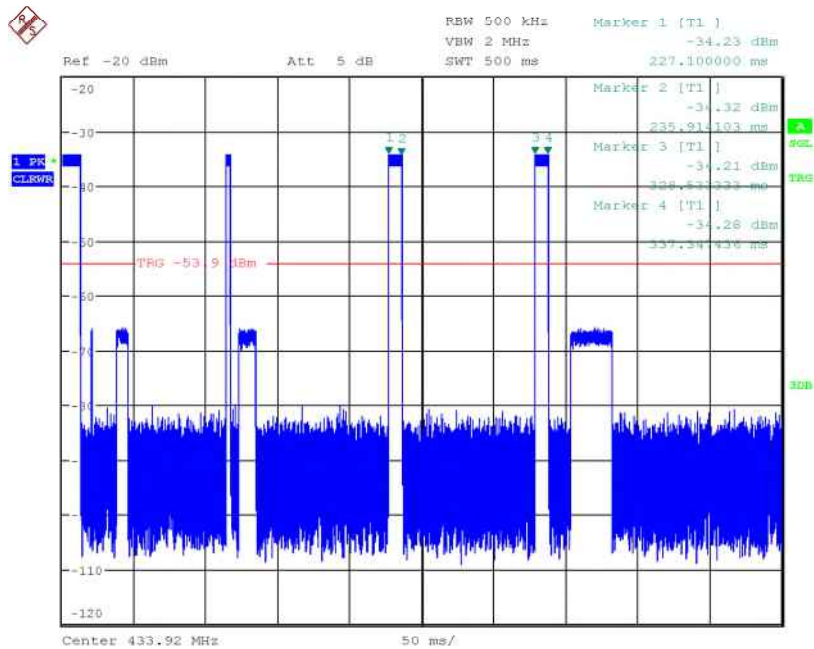
- ➔ The pulse train from the EUT contains 4 pulses and takes 338 ms in total
- ➔ less than 5 seconds §15.231(a)(1) -> pass
- ➔ No repetition



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Date: 26.NOV.2020 14:12:24

Diagram 40.01b – Closer view of pulse 1 (13.6 ms) and 2 (2.8 ms) (Pulse duration)



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Date: 26.NOV.2020 14:17:38

Diagram 40.01c – Closer view of pulse 3 (8.8 ms) and 4 (8.8 ms) (Pulse duration)

Pulse no.	Length [ms]	Remark:
1	13.6	Diagram 40.01b (direct read) -> Worst-Case Pulse length
2	2.8	From Diagram 40.01b (calculated)
3	8.8	From Diagram 40.01c (calculated)
4	8.8	From Diagram 40.01c (calculated)

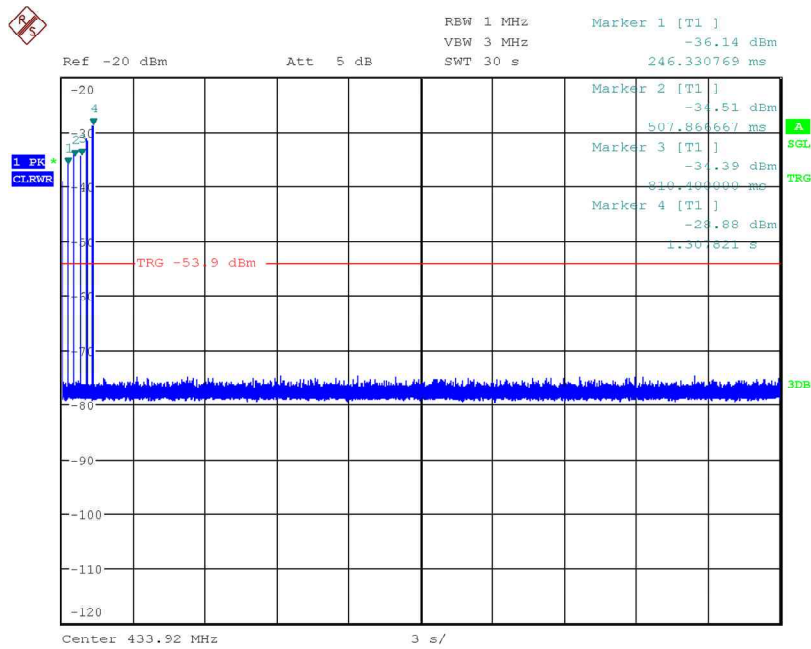
Cycle Time: $TX_{ON}\text{-Pulse1} + TX_{OFF} = 114.5 \text{ ms}$ (read from marker 2 in diagram 40.01b)

Only one Pulse can be observed during a period of 100 ms:

Therefore: Duty-Cycle [dB] related to 100 ms = $20 \cdot \log_{10}(13.6 \text{ ms}/100 \text{ ms}) = -17.33 \text{ dB}$

- ➔ Peak to AV correction factor for the measured field strength of the radiated emissions:
-17.33 dB

1.7.1.2 Op.5: Engine start, key fob unavailable

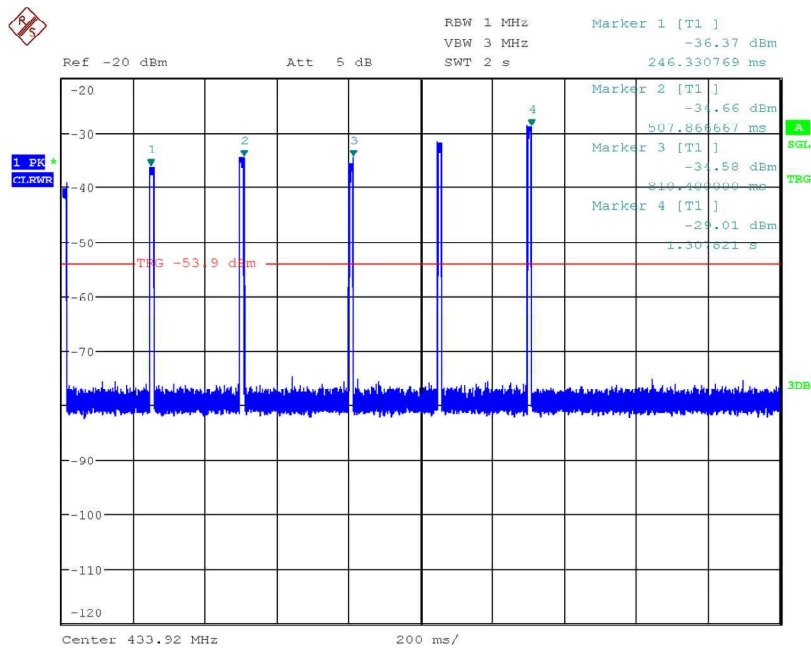


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Date: 26.NOV.2020 14:21:42

Diagram 40.02a – Overview with a time span of 30 s

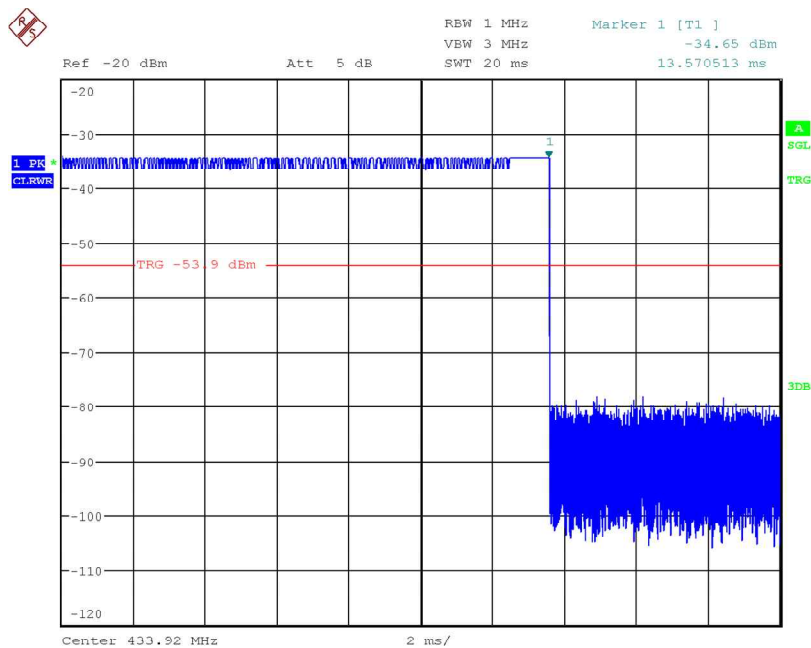
- ➔ The pulse train from the EUT contains 6 pulses and takes 1.3 s in total
- ➔ less than 5 seconds §15.231(a)(1) -> pass
- ➔ No repetition



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Date: 26.NOV.2020 14:20:22

Diagram 40.02b – Closer view of the pulse train with a time span of 2 s. Cycle time: 246.3 ms (read from marker 1)



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Date: 26.NOV.2020 14:24:40

Diagram 40.02c – Closer view of a single pulse (13.6 ms) (Pulse duration). All 6 pulses has the same pulse duration.

Pulse no.	Length [ms]	Remark:
1	13.6	From Diagram 40.02c (direct read)
2-6	13.6	All 6 pulses have the same pulse duration

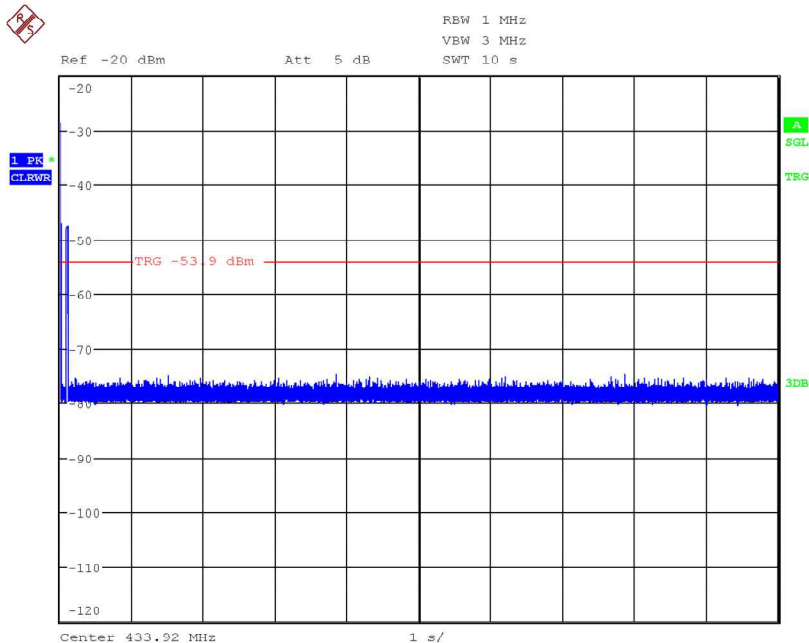
Cycle-Time: 246.3 ms (read from marker 1 in the diagram 40.02b)

One Pulse can be observed during a period of 100ms:

Therefore: Duty-Cycle [dB] related to 100 ms= $20 \cdot \log_{10}(13.6 \text{ ms}/100 \text{ ms}) = -17.33 \text{ dB}$

- ➔ Peak to AV correction factor for the measured field strength of the radiated emissions:
-17.33 dB

1.7.1.3 Op.6: Unlock door, key fob available

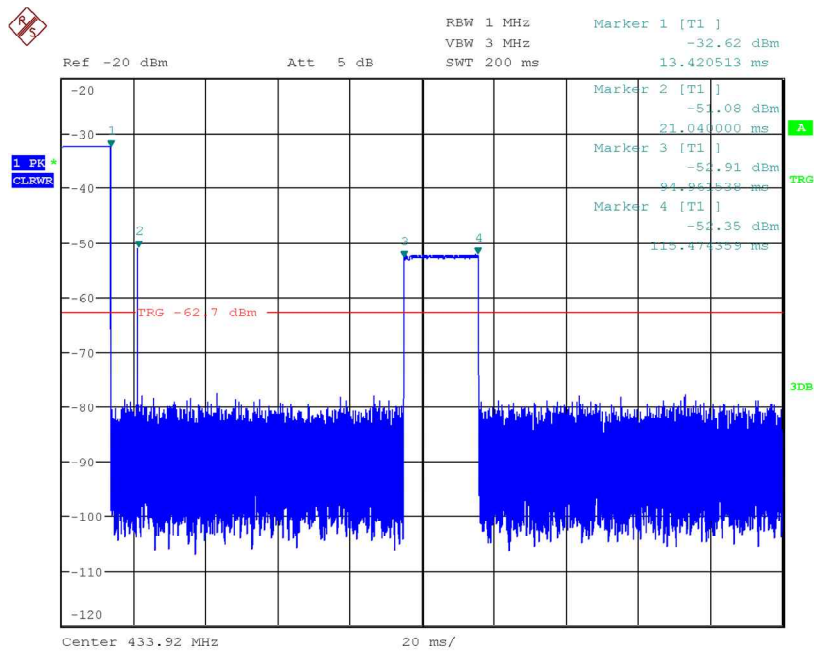


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Date: 26.NOV.2020 14:36:51

Diagram 40.03a – Overview with a time span of 10 s.

- ➔ Only one single pulse from the EUT in total
➔ less than 5 seconds §15.231(a)(1) -> pass
➔ No repetition



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Date: 26.NOV.2020 14:56:07

Diagram 40.03b – Closer view of pulse 1 (13.4 ms) (Pulse duration)

Pulse no.	Length [ms]	Remark:
1	13.4	Diagram 40.03b (direct read)

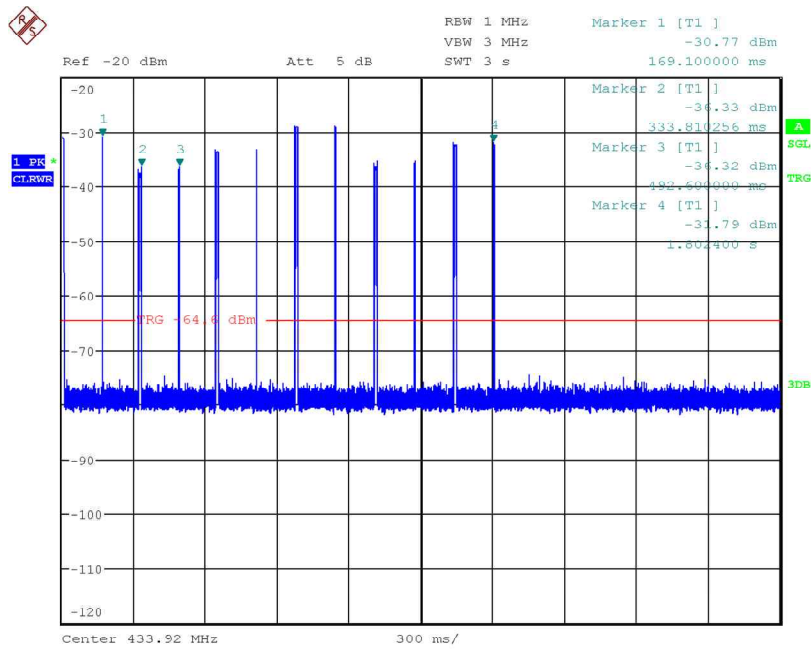
Cycle Time: - (one single pulse)

Only one Pulse can be observed during a period of 100 ms:

Therefore: Duty-Cycle [dB] related to 100 ms = $20 \cdot \log_{10}(13.4 \text{ ms}/100 \text{ ms}) = -17.45 \text{ dB}$

- ➔ Peak to AV correction factor for the measured field strength of the radiated emissions:
-17.45 dB

1.7.1.4 Op.7: Unlock door, key fob unavailable

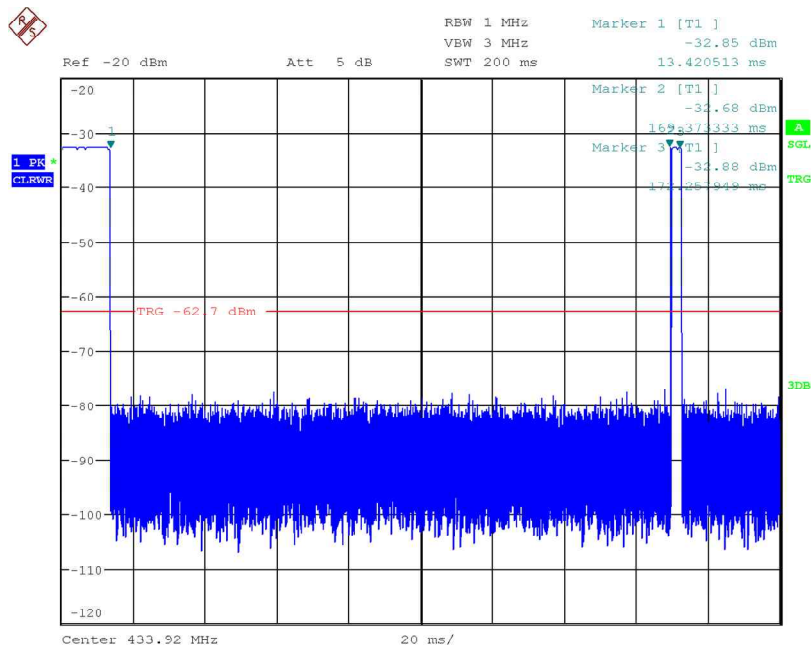


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Date: 26.NOV.2020 12:06:25

Diagram 40.04a – Overview with a time span of 3 s

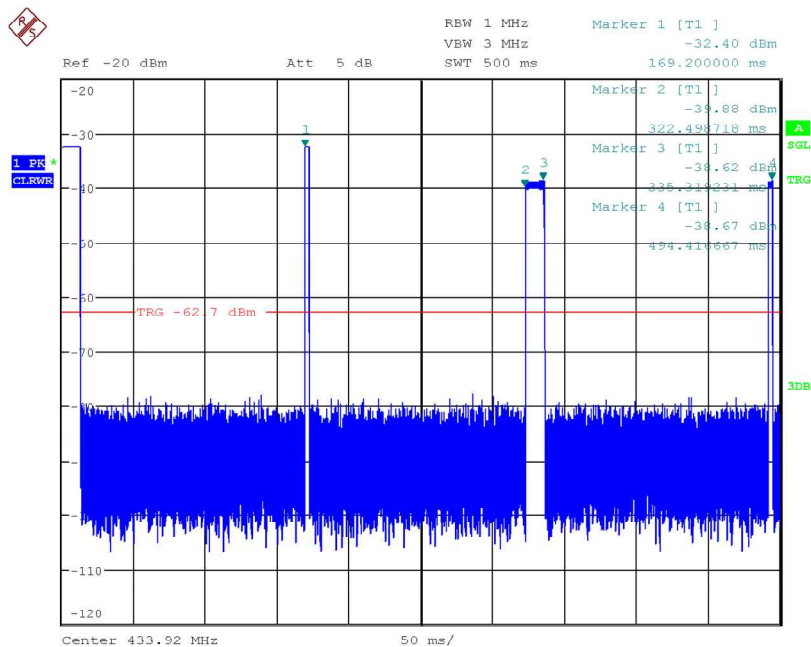
- ➔ The pulse train from the EUT contains 12 pulses and takes 1.8 s in total
- ➔ less than 5 seconds §15.231(a)(1) -> pass
- ➔ No repetition



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Date: 26.NOV.2020 15:01:14

Diagram 40.04b – Closer view of pulse 1 (13.4 ms) and pulse 2 (2.9 ms) (Pulse duration). Cycle time: 169.4 ms (read from marker 2)



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Diagram 40.04c – Closer view of pulses 1-4. The longer pulse and the shorter pulse alternate for 6 times within the pulse train.

Pulse no.	Length [ms]	Remark:
1	13.4	From Diagram 40.04b (direct read) -> Worst-Case Pulse length
2	2.9	From Diagram 40.04b (calculated)
3, 5, 7, 9, 11	13.4	Repetition of pulse 1 with the same pulse duration
4, 6, 8, 10, 12	2.9	Repetition of pulse 2 with the same pulse duration

Cycle-Time: 169.4 ms (read from marker 2 in the diagram 40.04b)

One Pulse can be observed during a period of 100ms:

Therefore: Duty-Cycle [dB] related to 100 ms= $20 \cdot \log_{10}(13.4 \text{ ms}/100 \text{ ms}) = -17.45 \text{ dB}$

- ➔ Peak to AV correction factor for the measured field strength of the radiated emissions:
-17.45 dB

1.7.2 Periodical operation (§15.231(a)(3))

Not visible/detectable

End of Annex 1