

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

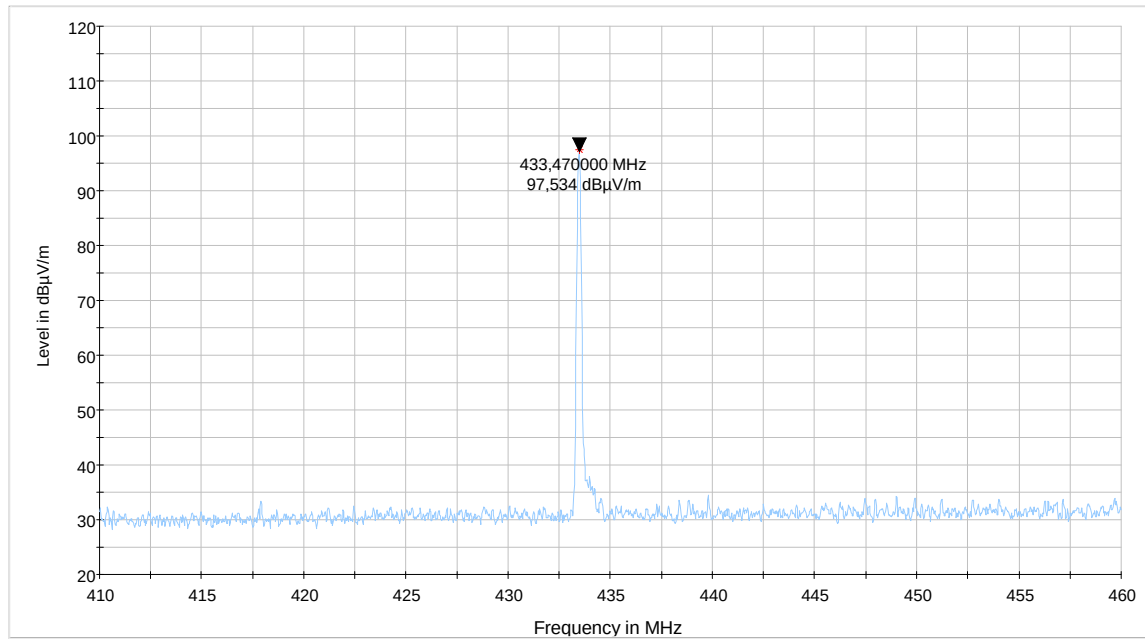


Diagram 3.01b: EUT at standing position (see limit in the main test report)

AV-Value: 97.53 – 17.33 dB (Timing) = 80.2 dBμV/m@3m

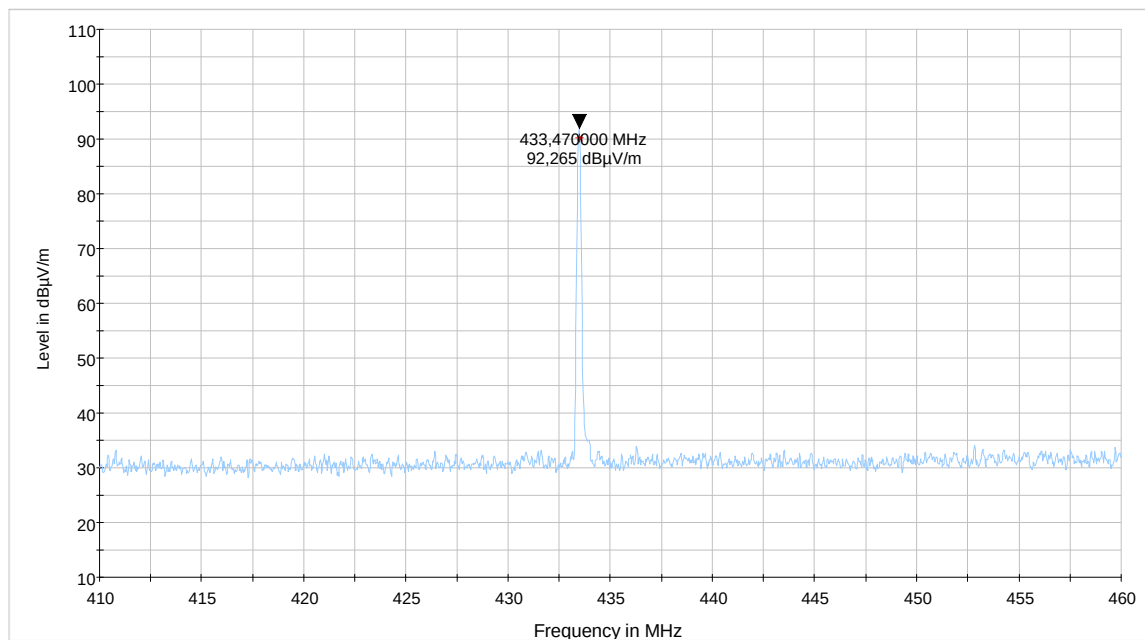


Diagram 3.03b: EUT at lying position (see limit in the main test report)

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

1.1.2 Measurements on antenna 2, ch3

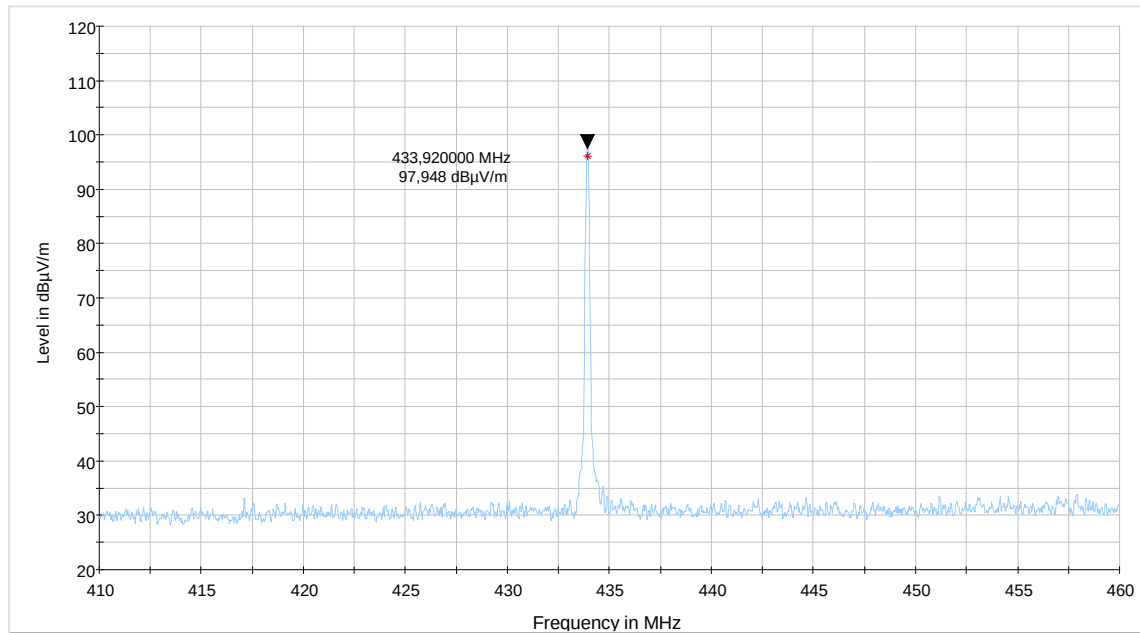


Diagram 3.04b: EUT at standing position (see limit in the main test report)

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

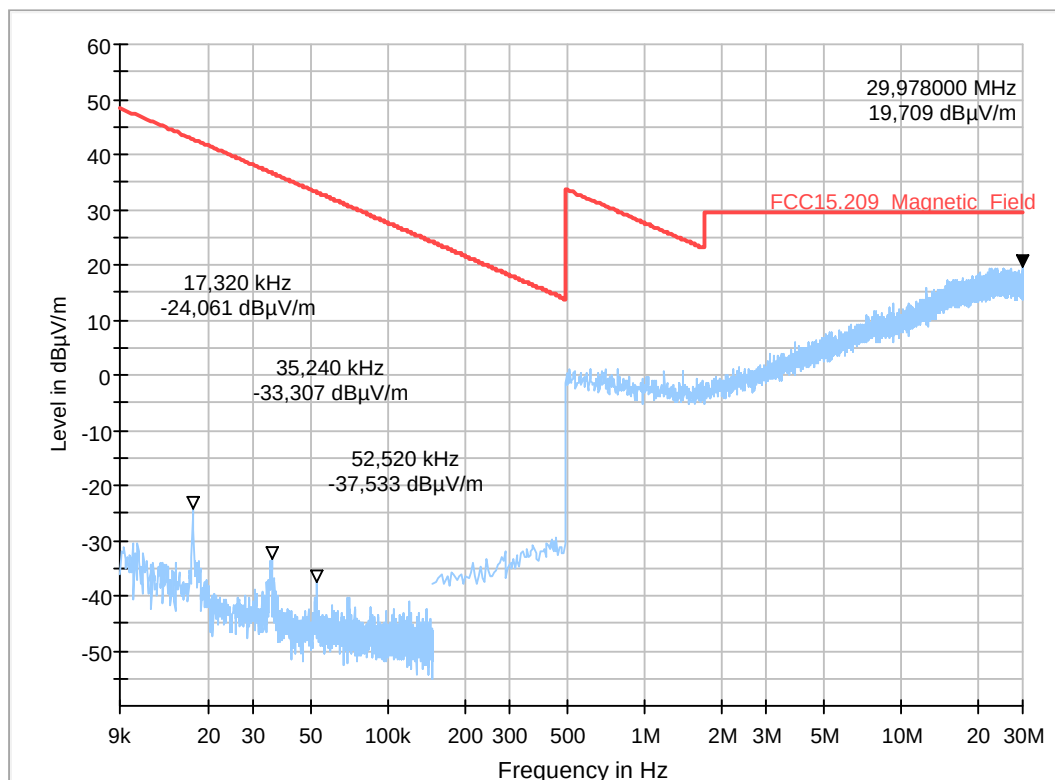
2.01_RSE_TX_Ch1_RF-Port1_EUT_standing

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

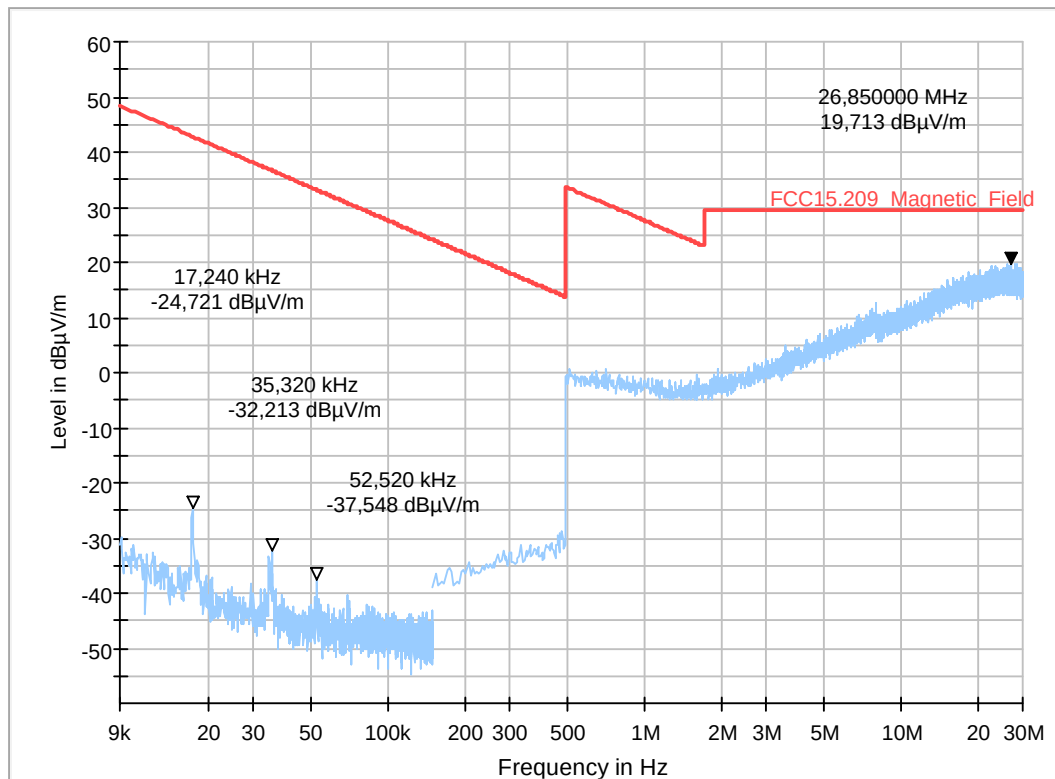


2.02_RSE_TX_Ch1_RF-Port1_EUT_lying

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

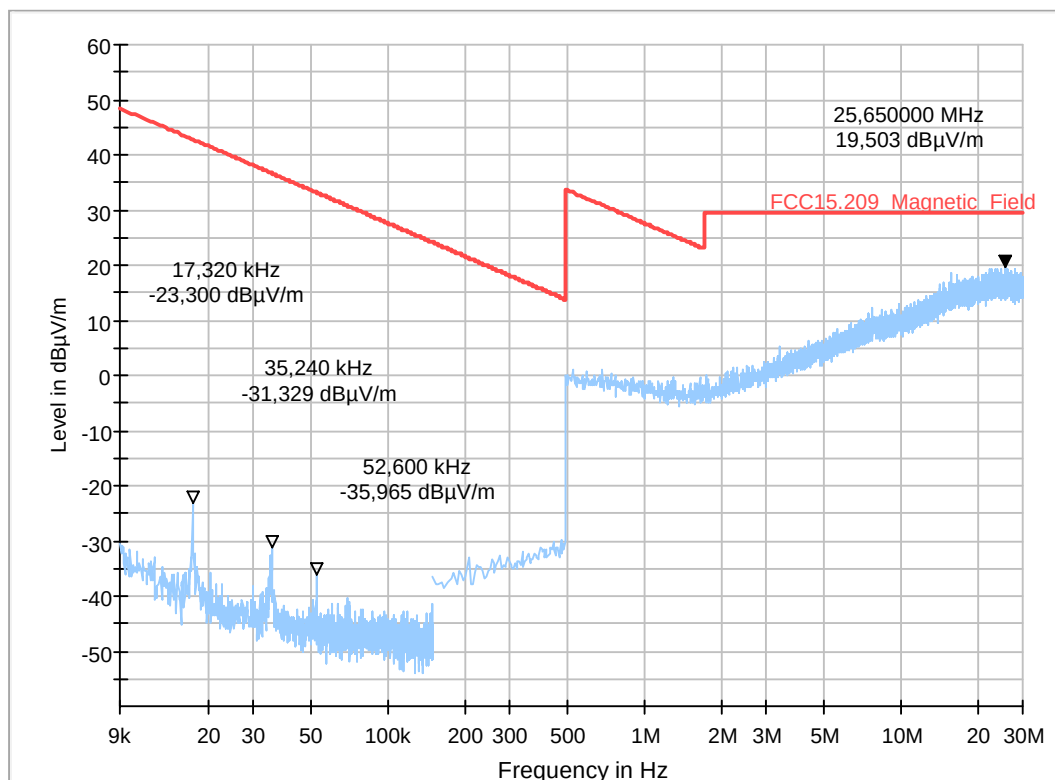
2.03_RSE_RX_Ch2_RF-Port2_EUT_lying

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



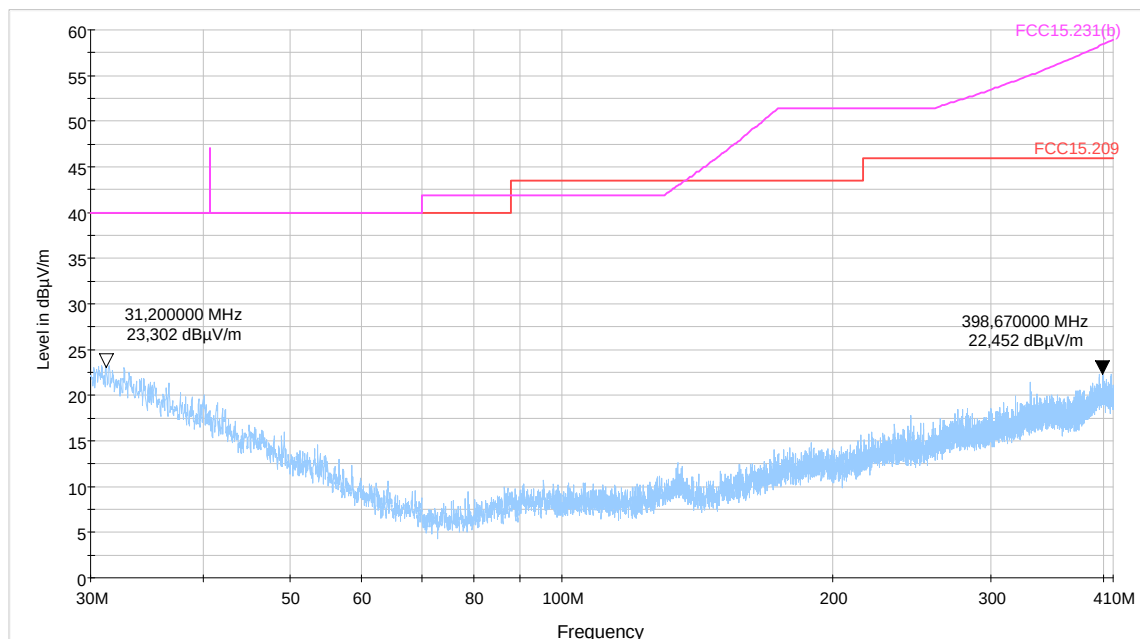
1.3 Radiated emissions in the frequency range 30 to 1000 MHz

1.3.1 Measurements on antenna 1, ch1

3.01a_RSE_TX_Ant1Ch1_EUT_standing

Common Information

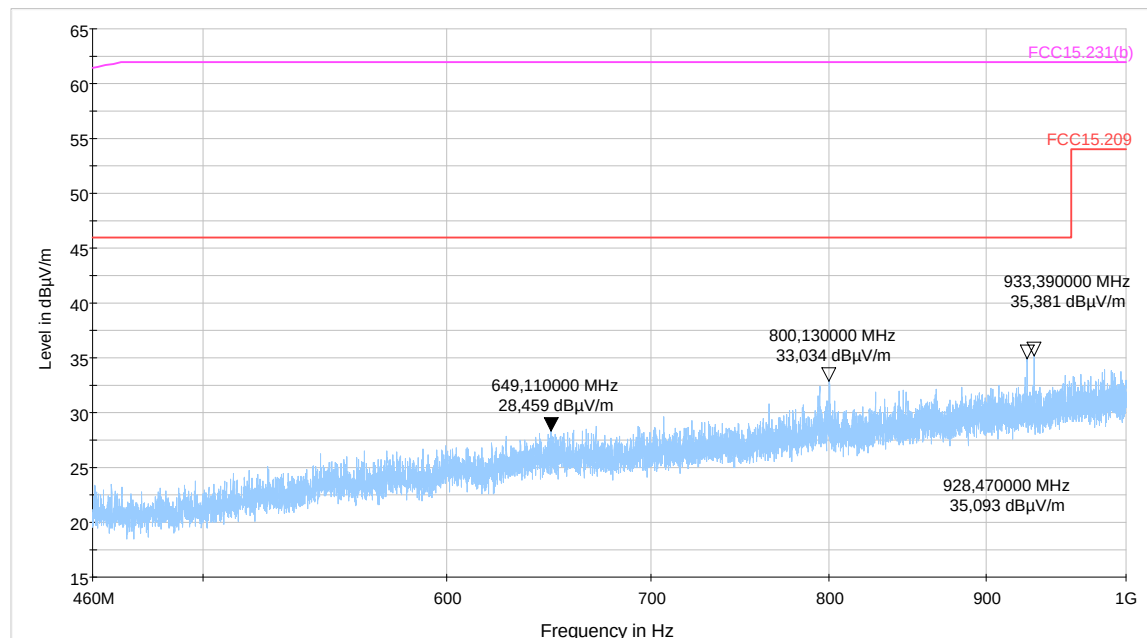
Test description:	Electric Field Strength Measurement
Test site and distance:	Ref.-Nr. 441 Semi Anechoic Room (SAR) with 3 m measurement distance
Version of Testsoftware:	EMC32 V9.25.0
Distance correction:	not used
Used filter:	not used
Test specification.:	FCC §15.209/§15.231 / RSS-210, Issue9, B.6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

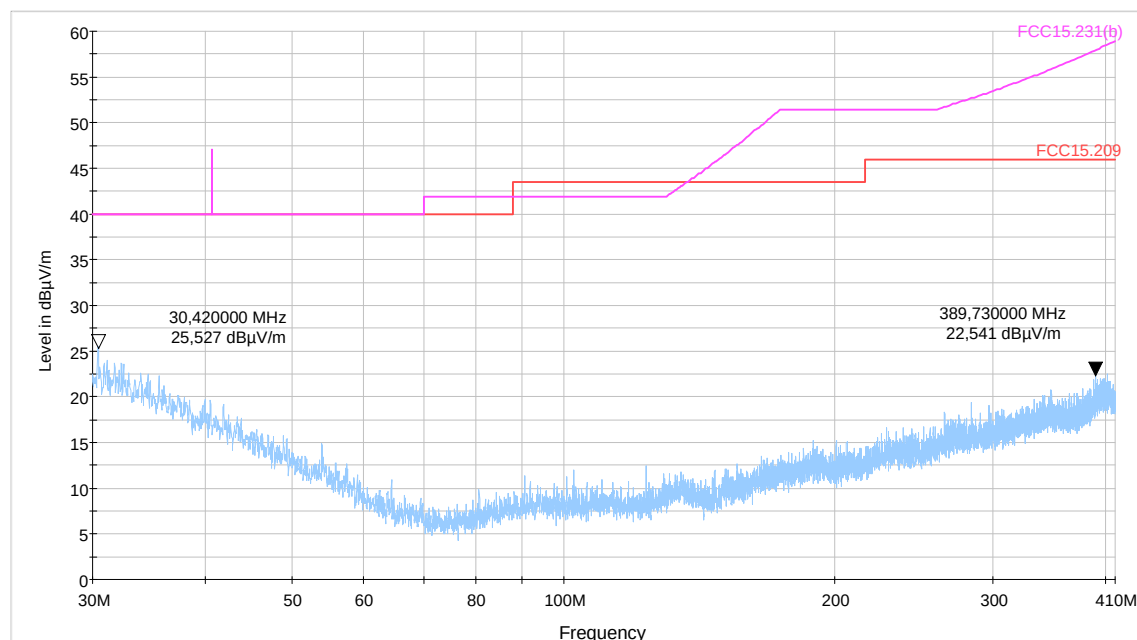


Remark: The marked emissions at 800 MHz, 928 MHz and 933 MHz are external, which are irrelevant to the limit.

3.03a_RSE_TX_Ant1Ch1_EUT_lying

Common Information

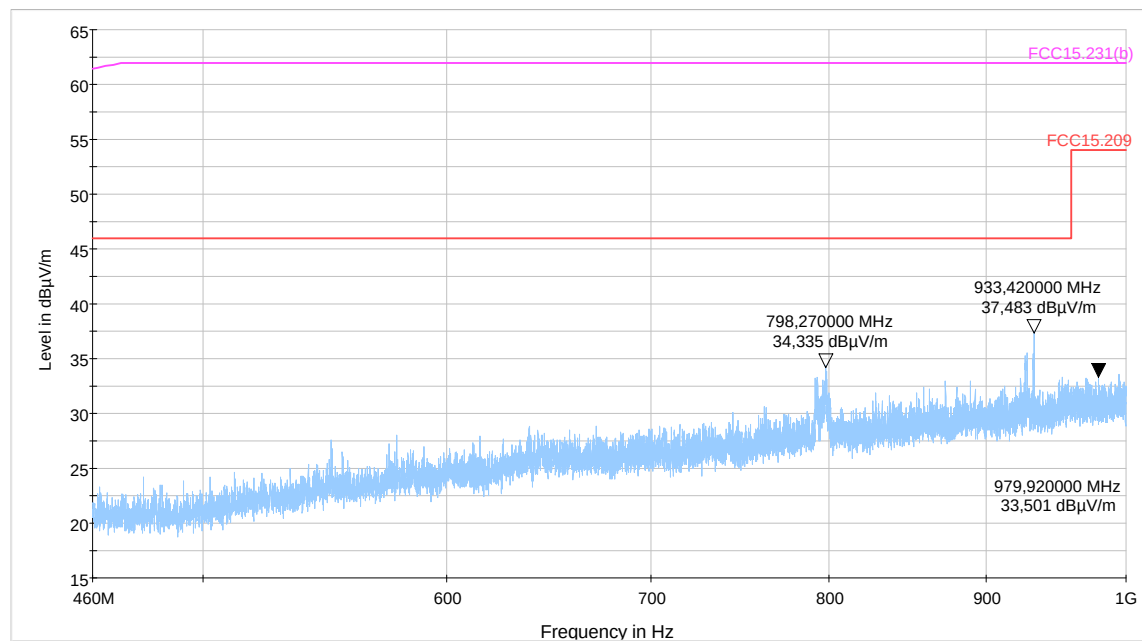
Test description:	Electric Field Strength Measurement
Test site and distance:	Ref.-Nr. 441 Semi Anechoic Room (SAR) with 3 m measurement distance
Version of Testsoftware:	EMC32 V9.25.0
Distance correction:	not used
Used filter:	not used
Test specification.:	FCC §15.209/§15.231 / RSS-210, Issue9, B.6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



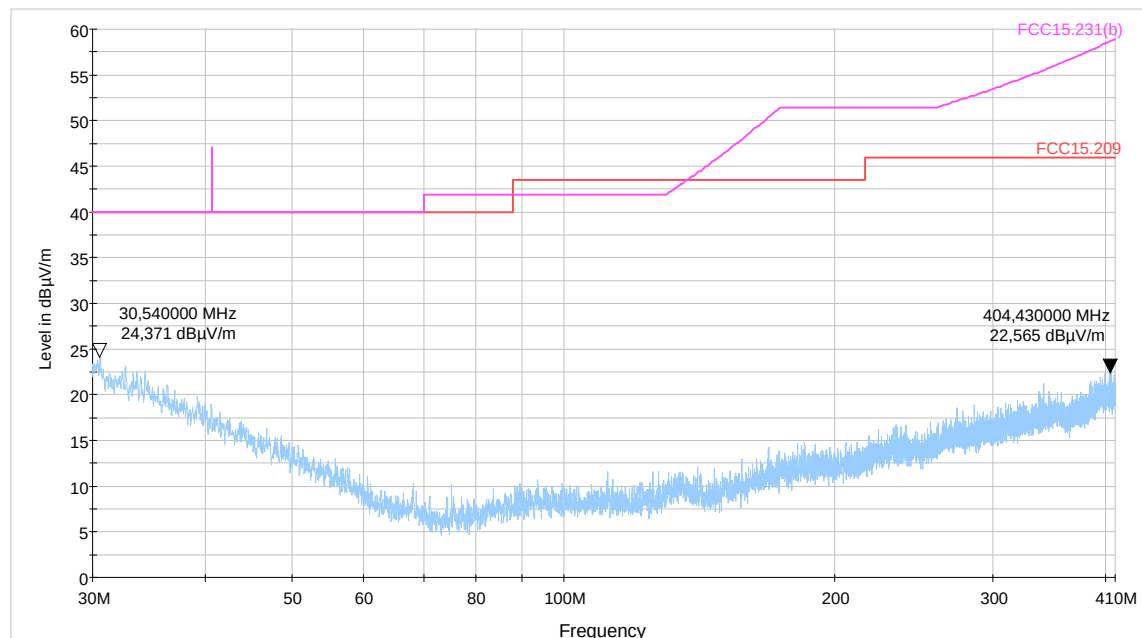
Remark: The marked emissions at 798 MHz and 933 MHz are external, which are irrelevant to the limit.

1.3.2 Measurements on antenna 2, ch3

3.02a_RSE_TX_Ant2Ch3_EUT_standing

Common Information

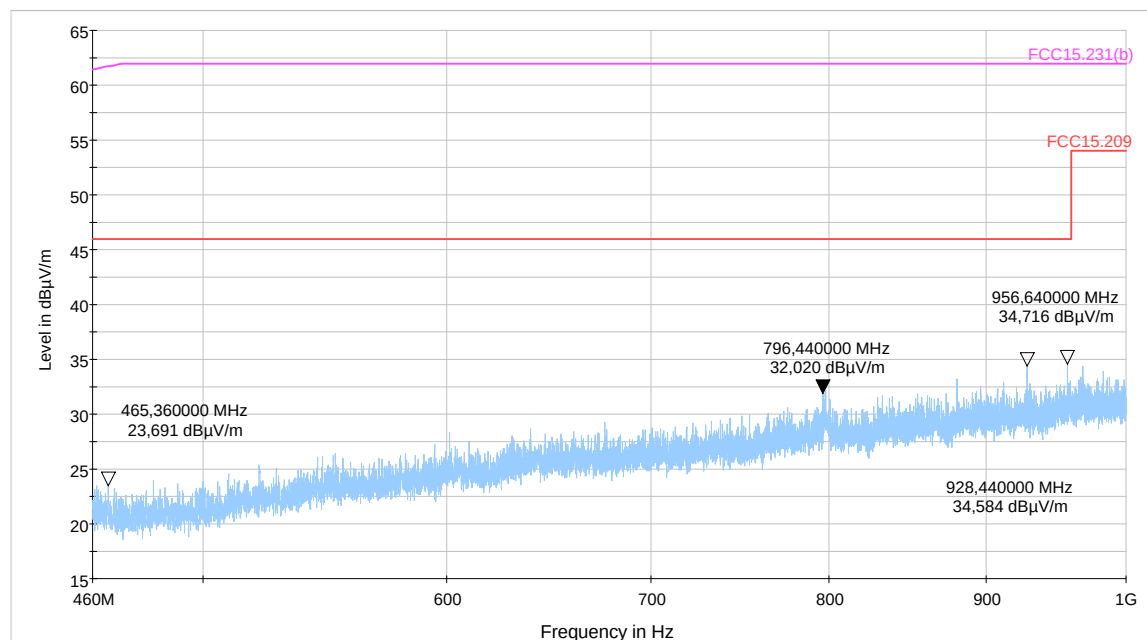
Test description:	Electric Field Strength Measurement
Test site and distance:	Ref.-Nr. 441 Semi Anechoic Room (SAR) with 3 m measurement distance
Version of Testsoftware:	EMC32 V9.25.0
Distance correction:	not used
Used filter:	not used
Test specification.:	FCC §15.209/§15.231 / RSS-210, Issue9, B.6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



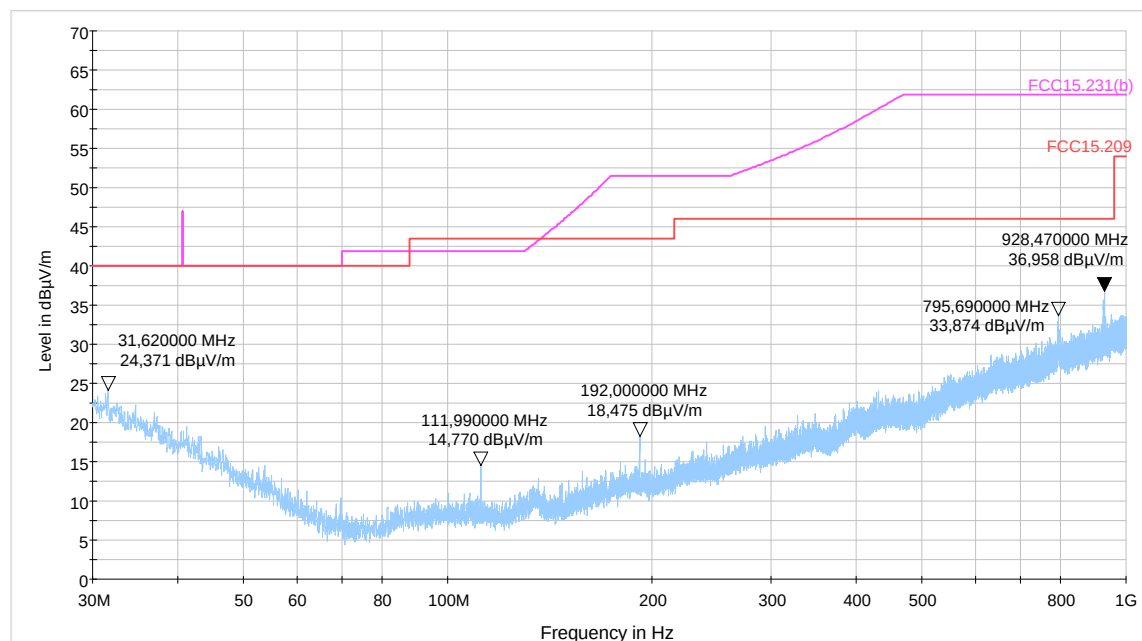
Remark: The marked emissions at 796 MHz and 928 MHz are external, which are irrelevant to the limit.

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.

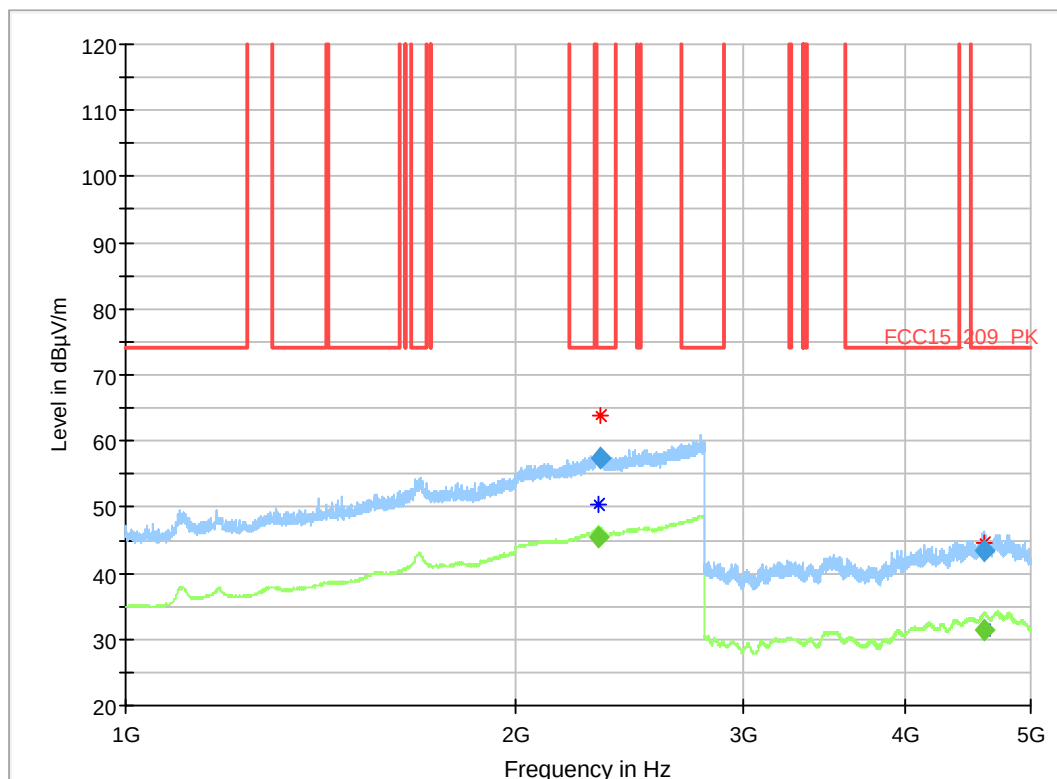
1.4 Radiated emissions in the frequency range above 1000MHz

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

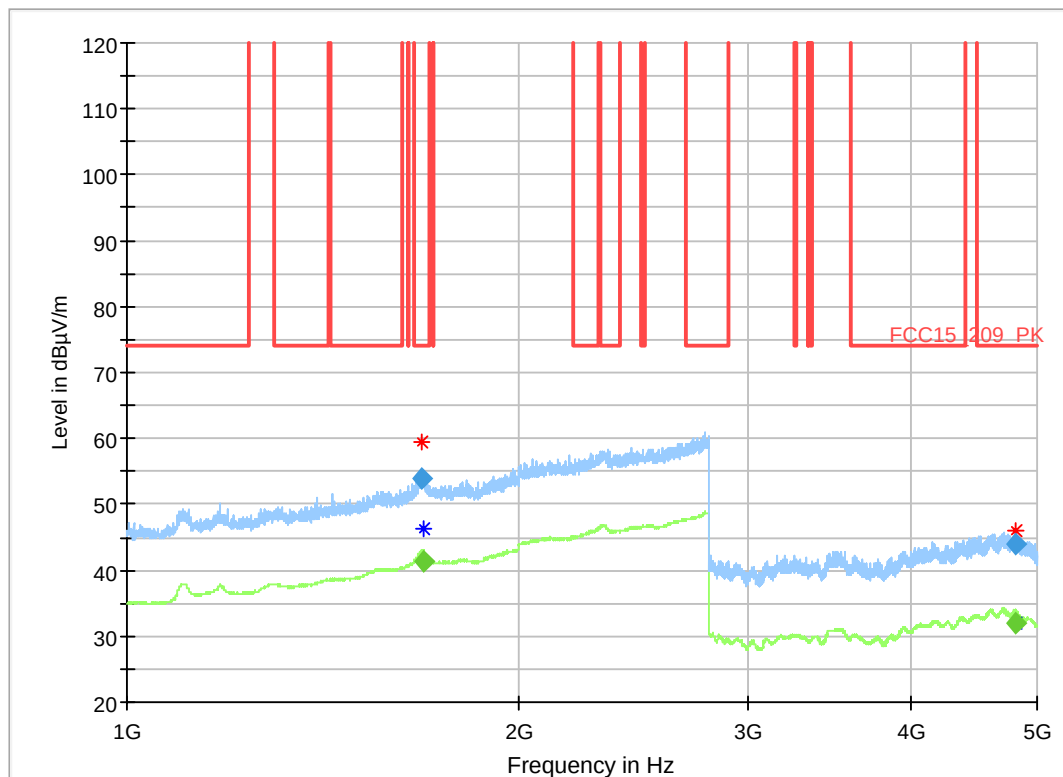
Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB/m)
2321.200000	---	45.42	---	---	100.0	1000.000	155.0	H	221.0	0.0	37
2326.000000	57.35	---	74.00	16.65	100.0	1000.000	155.0	V	195.0	0.0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

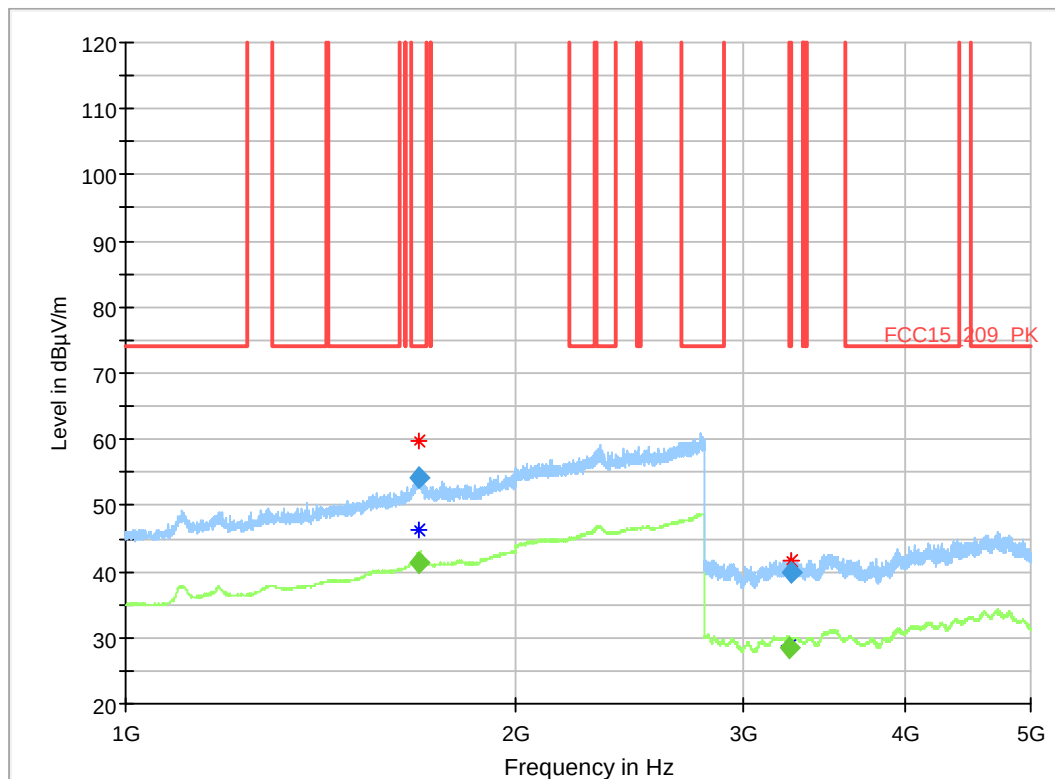
Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB/m)
1683.600000	53.85	---	74.00	20.15	100.0	1000.000	155.0	V	339.0	0.0	34
1690.400000	---	41.39	---	---	100.0	1000.000	155.0	V	36.0	0.0	34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

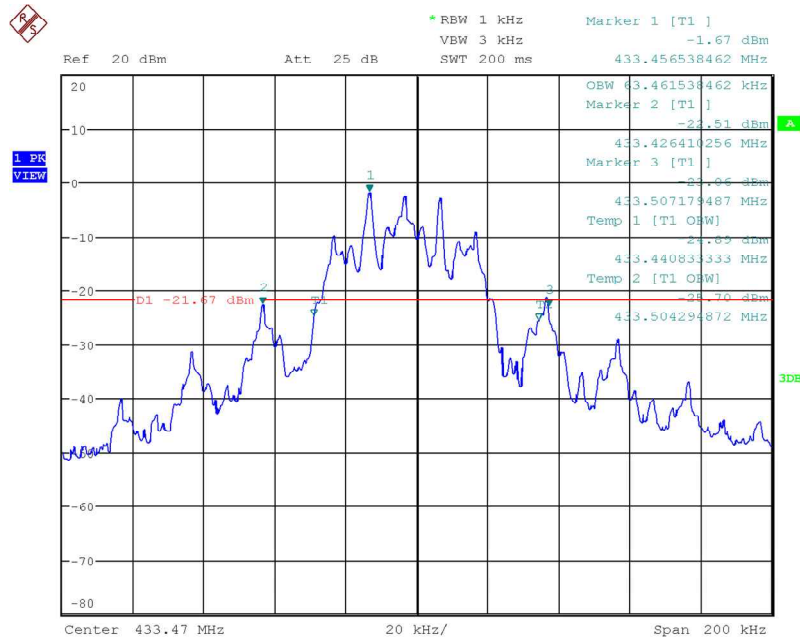


Final Result

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

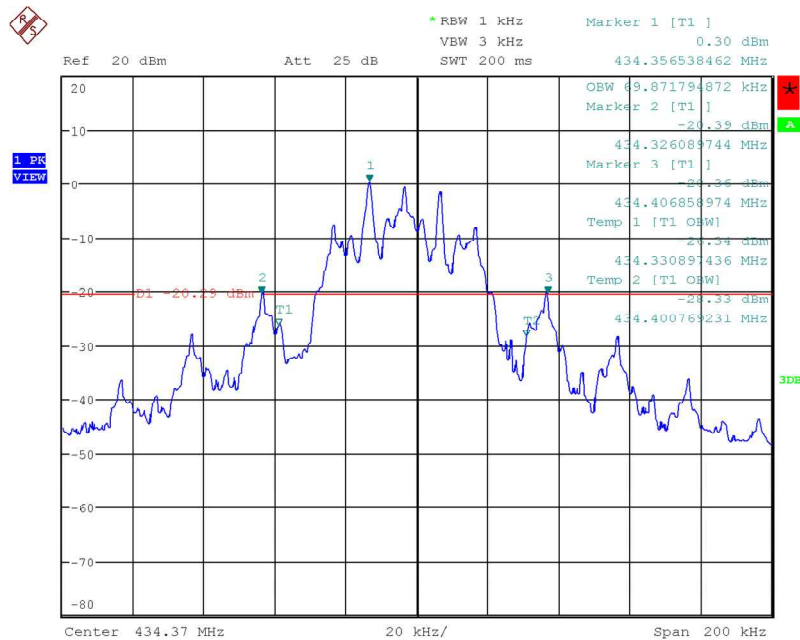
1.5 20dBc bandwidth & 99% occupied bandwidth

1.5.1 Measurements on antenna 1, ch1



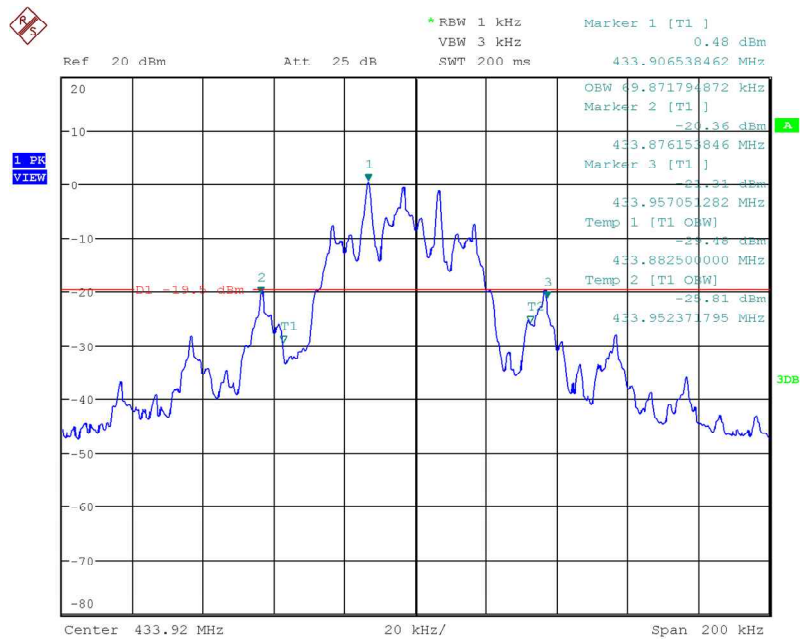
Date: 25.AUG.2020 13:11:52

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

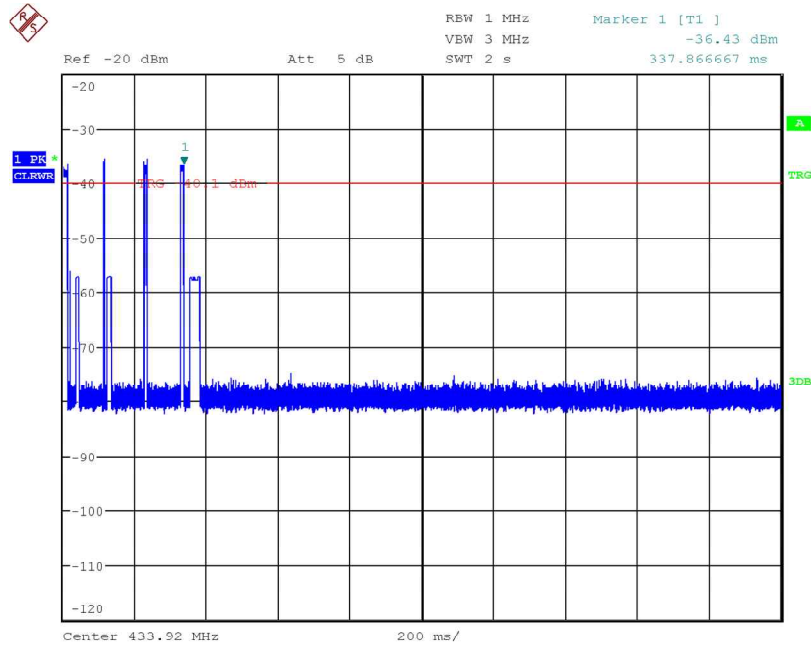
Worst-Case Duty-Cycle correction = -17.33 dB (Section 1.8.1.1)

1.7 Transmission characteristics

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

Remark: Following diagrams show transmission pulses from both the EUT and the AE (key fob). The pulses with higher level of power are from the EUT, the lower ones are from the AE (key fob). The pulses from the key fob are irrelevant to the evaluation of the transmission characteristics.

1.7.1.1 Op.4: Engine start, key fob available

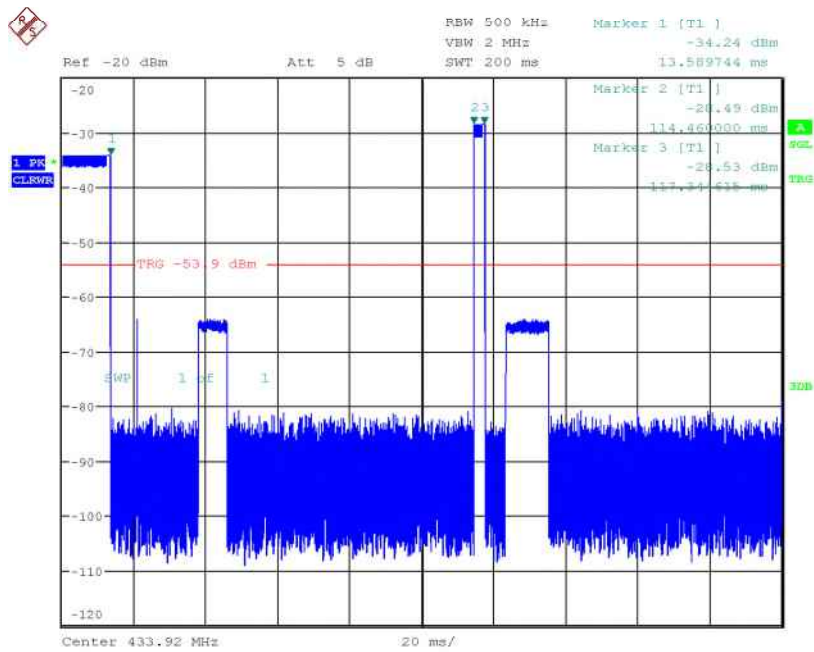


neu

Date: 26.NOV.2020 13:44:41

Diagram 40.01a – Overview with a time span of 2 s.

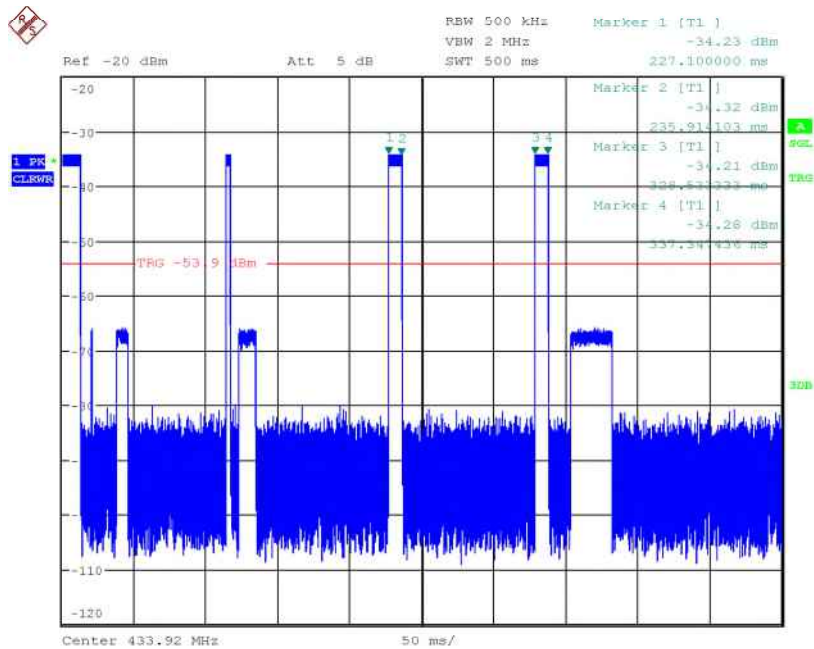
- ➔ The pulse train from the EUT contains 4 pulses and takes 338 ms in total
- ➔ less than 5 seconds §15.231(a)(1) -> pass
- ➔ No repetition



neu

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)



neu

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)

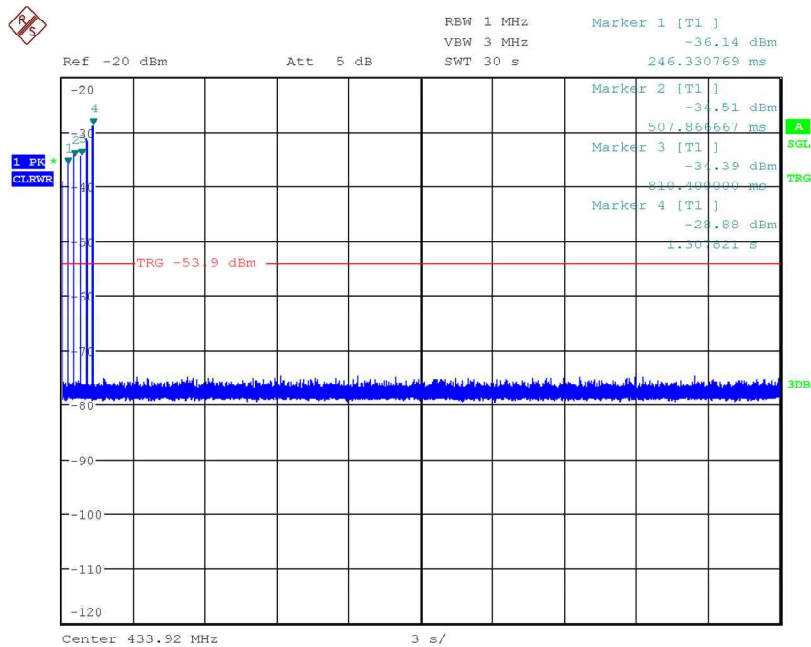
Cycle Time: $TX_{ON}\text{-Pulse1} + TX_{OFF} = 114.5 \text{ ms}$ (read from marker 2 in diagram 40.01b)

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

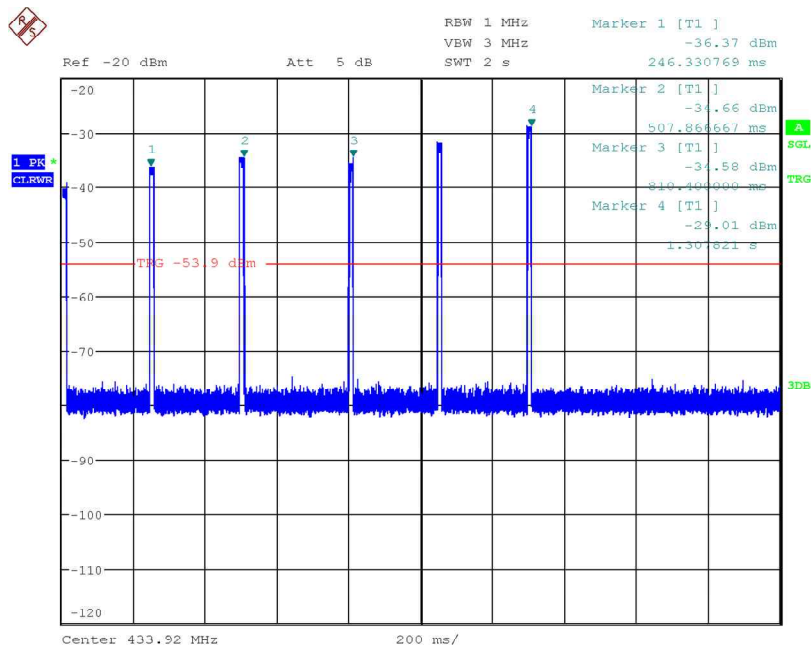


neu

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

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

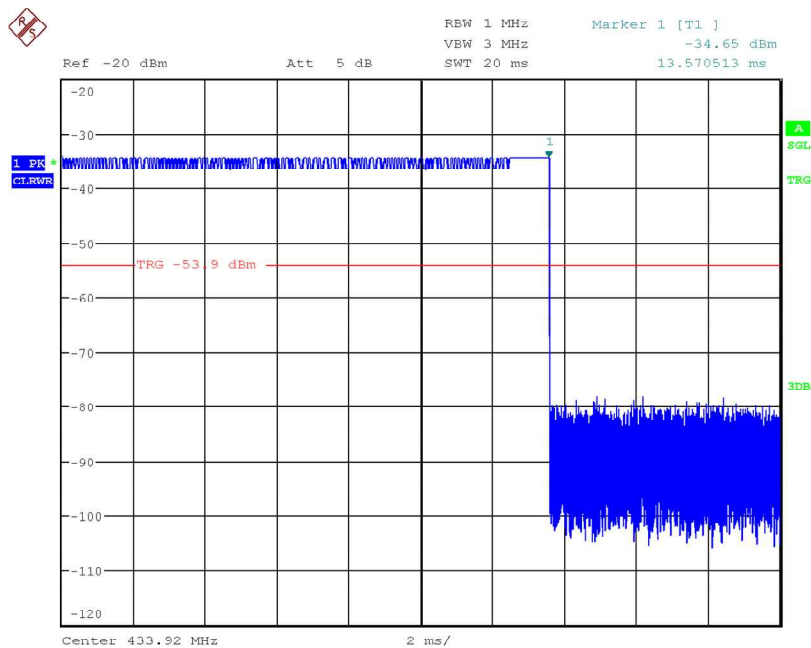
- ➔ The pulse train from the EUT contains 6 pulses and takes 1.3 s in total
- ➔ less than 5 seconds §15.231(a)(1) -> pass
- ➔ No repetition



neu

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)



neu

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

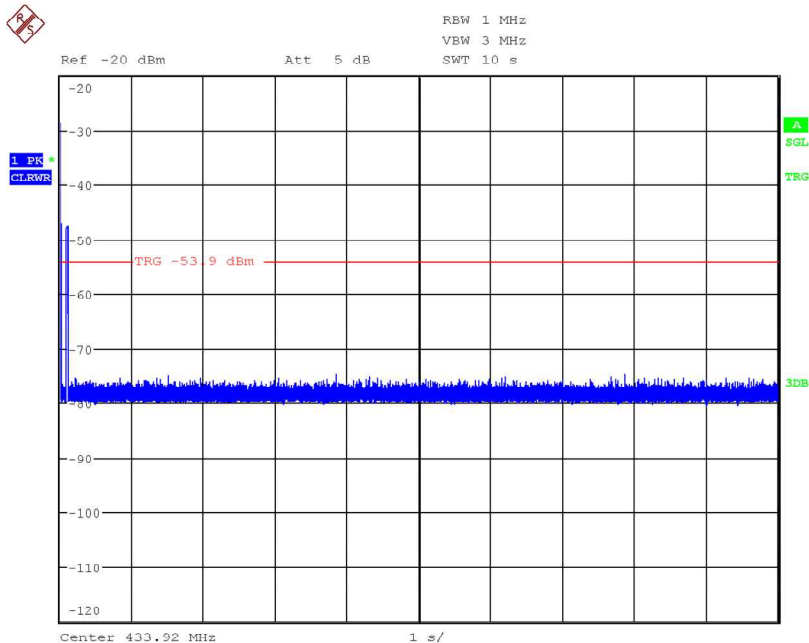
Cycle-Time: 246.3 ms (read from marker 1 in the diagram 40.02b)

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

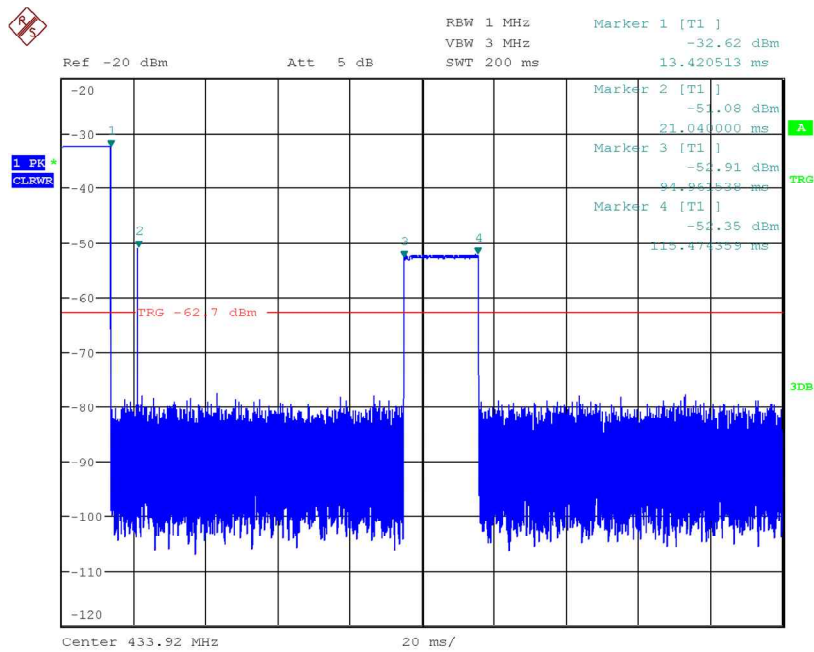


neu

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



neu

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)

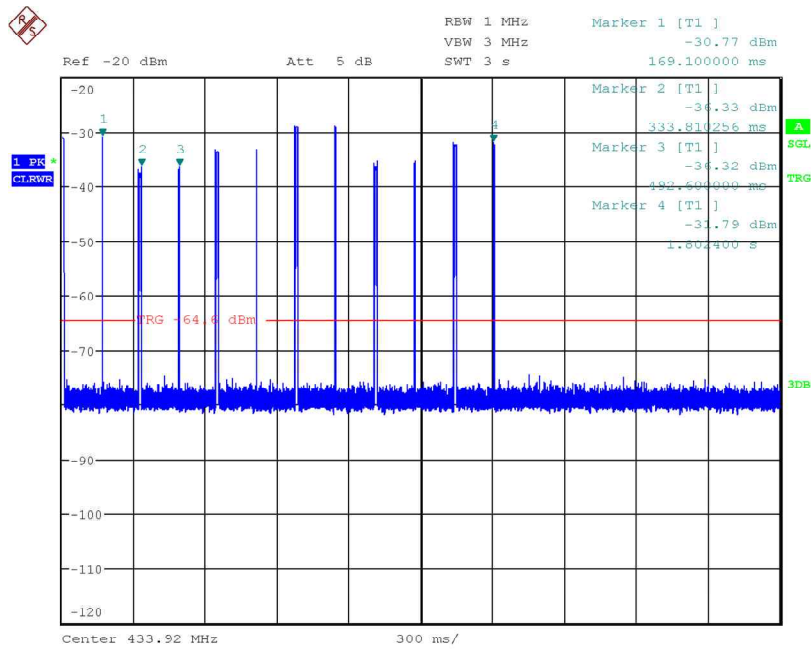
Cycle Time: - (one single pulse)

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

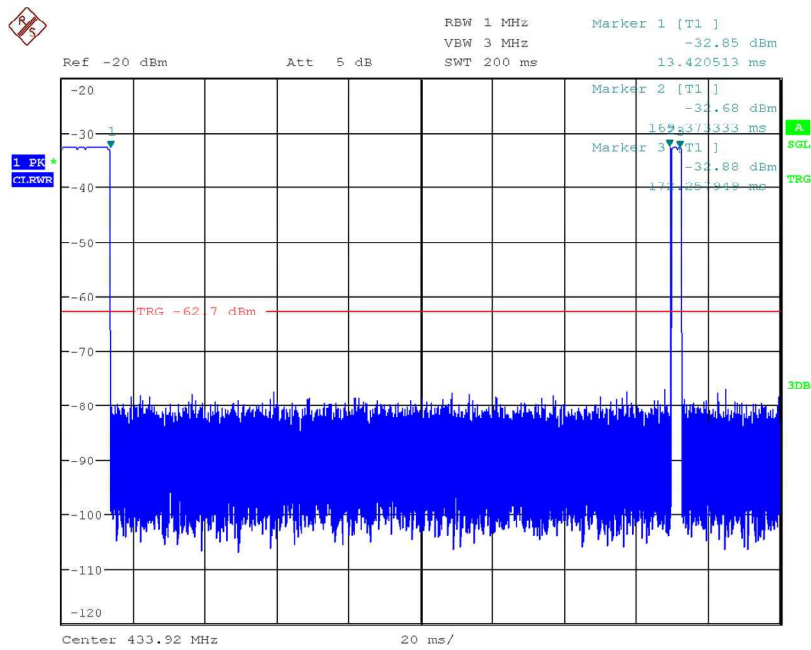


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Diagram 40.04a – Overview with a time span of 3 s

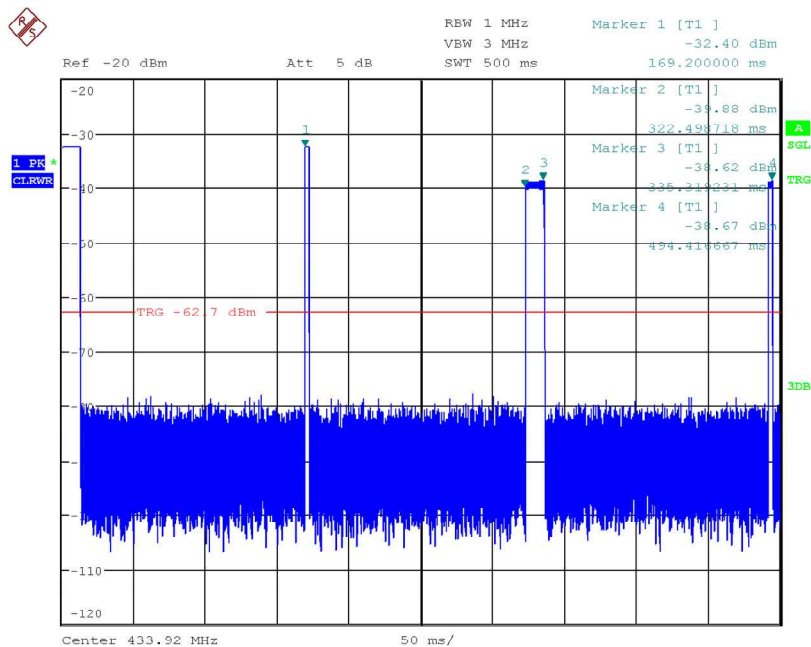
- ➔ The pulse train from the EUT contains 12 pulses and takes 1.8 s in total
- ➔ less than 5 seconds §15.231(a)(1) -> pass
- ➔ No repetition



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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