Annex 1: Measurement diagrams to
T E S T R E P O R T
No.: 19-1-0198101T01a

According to:

Title 47
FCC Regulations Subpart 15C
§15.231(e)
ISED-Regulations
RSS-Gen, Issue 5
RSS-210, Issue 10

for

PACIFIC Industrial Co., Ltd.

Flex-Sens
TPMS transmitter (Universal Sensor)
PMV-E102

FCC-ID: PAXPMVE102
ISED: 3729A-PMVE102

Laboratory Accreditation and Listings
Accredited EMC-Test Laboratory
accredited according to DIN EN ISO/IEC 17025:2018

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Table of contents

1. Measurement diagrams

1.1. Fundamental field strength (15.231(e))

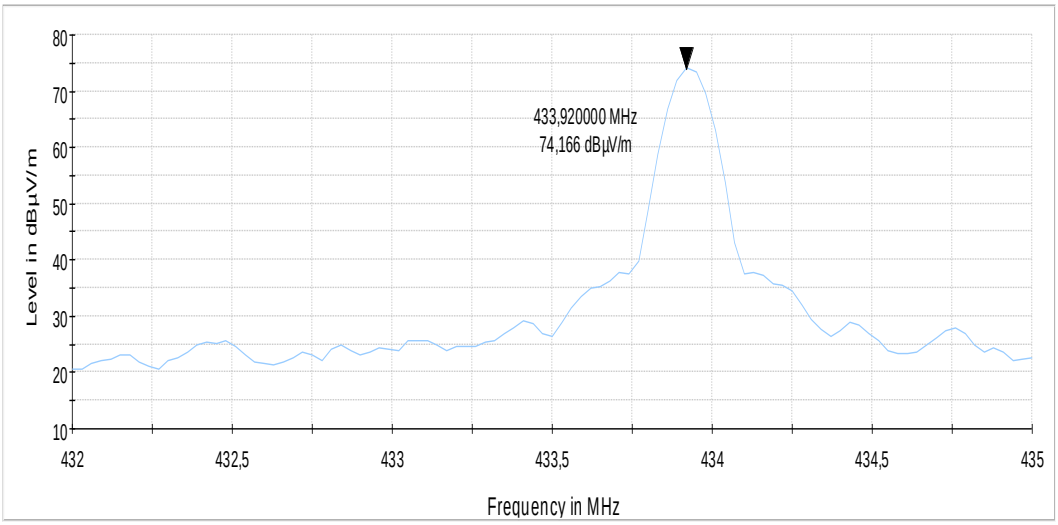


Diagram 3.01: EUT is at standing position and transmits continuous wave.
PK-Value: 74.17 - 9.71 dB (Averaged timing over 100 ms) = 64.46 dBµV/m @ 3m

Limit in range 260-470MHz:
Field strength = 20*log10((16.67 x $f_{|MHz}$)-2833.33) = 20*log10(4400.12 µV/m) = 72.87 dBµV/m

Margin to limit = 8.41 dB -> Pass

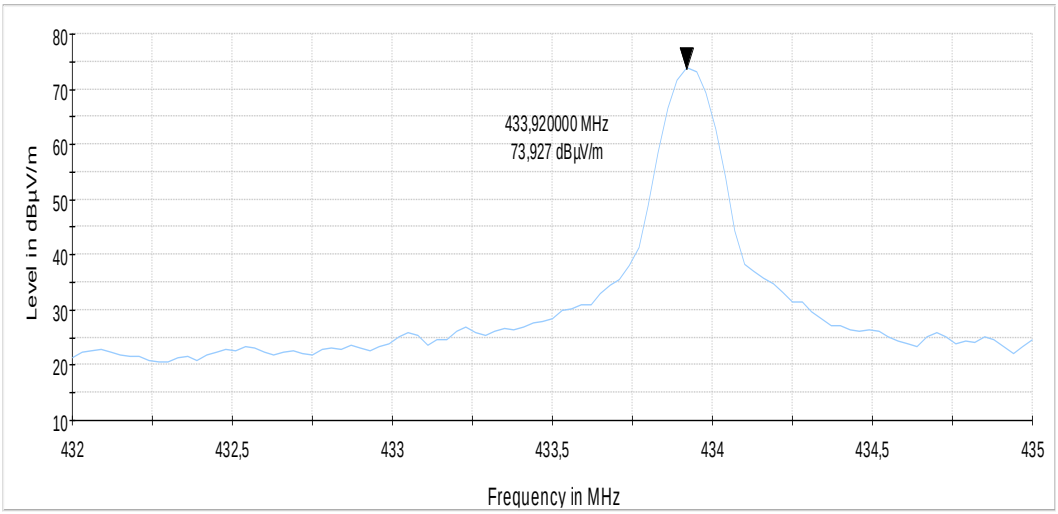


Diagram 3.02, EUT is at lying position and transmits continuous wave.
PK-Value: 73.93 - 9.71 dB (Averaged timing over 100 ms) = 64.22 dBµV/m @ 3m

Limit: 72.87 dBµV/m

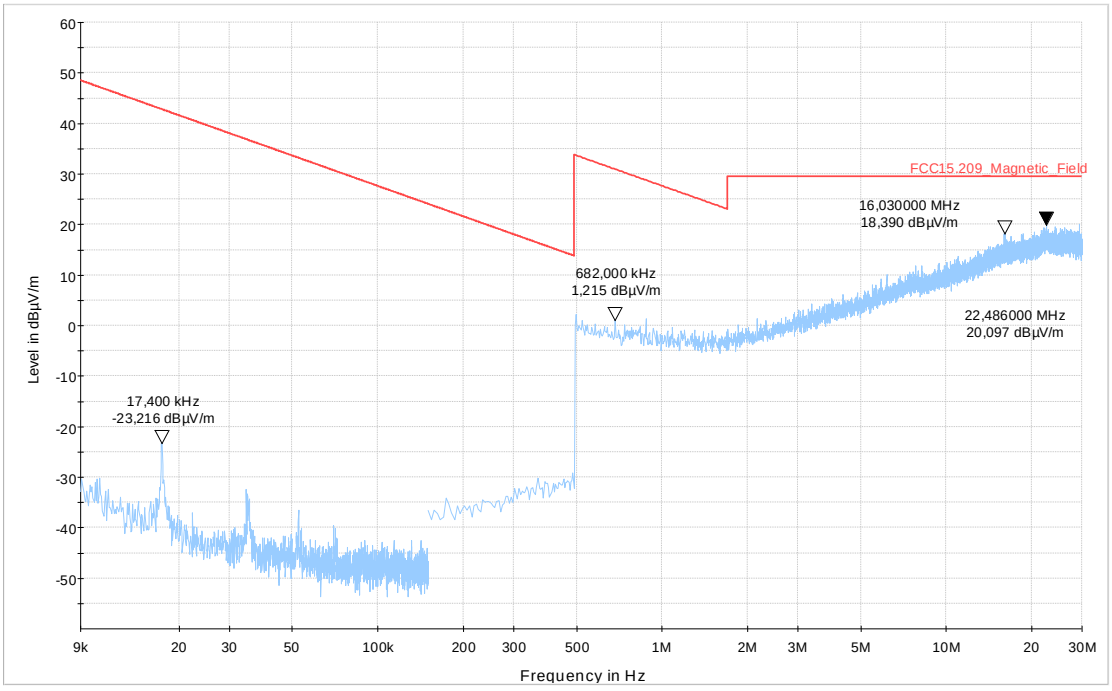
Margin to limit = 8.65 dB -> Pass

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

2.01_RSE_TX_standing

Common Information

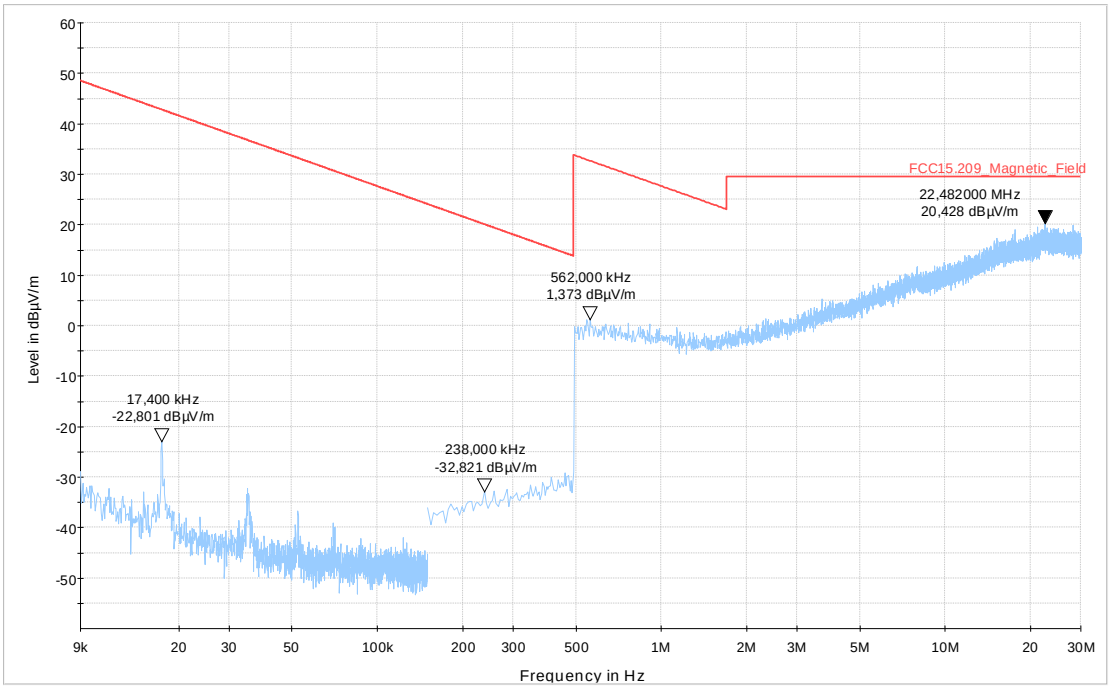
Test Description:	Magnetic Field Strength Measurement related to 30/300 m distance
Test Site Location:	Ref.-Nr. 441 Semi Anechoic Chamber (SAC1) with 3 m measurement
Version of Testsoftware:	EMC32 V10.50.0
Used Filter:	bypass
Test Standard:	FCC 15.205 § 15.209; RSS-Gen: Issue 5
Operator:	GHu
Operating Mode:	434 MHz TX CW
Power during tests:	3 V battery
Comment 1:	S10
Environmental Conditions::	Humidity : 38% rH; Temperature: 20 °C
EUT Setup:	standing
Verdict:	Passed
Comment:	-



2.02_RSE_TX_lying

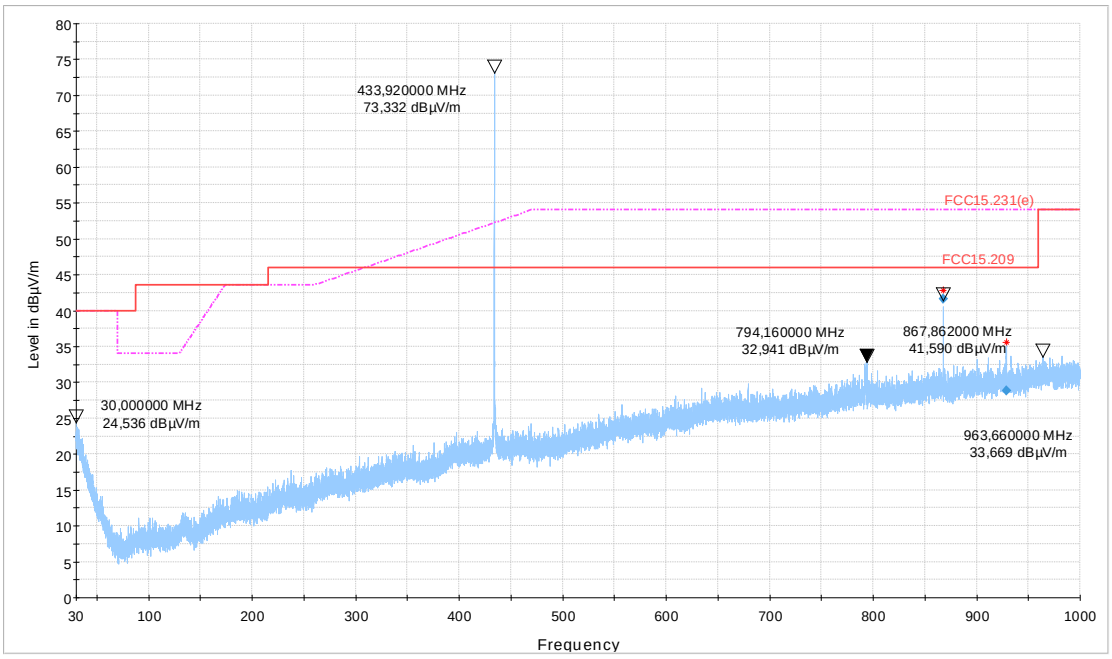
Common Information

Test Description:	Magnetic Field Strength Measurement related to 30/300 m distance
Test Site Location:	Ref.-Nr. 441 Semi Anechoic Chamber (SAC1) with 3 m measurement
Version of Testsoftware:	EMC32 V10.50.0
Used Filter:	bypass
Test Standard:	FCC 15.205 § 15.209; RSS-Gen: Issue 5
Operator:	GHu
Operating Mode:	434 MHz TX CW
Power during tests:	3 V battery
Comment 1:	S10
Environmental Conditions::	Humidity : 40% rH; Temperature: 21 °C
EUT Setup:	lying
Verdict:	Passed
Comment:	-



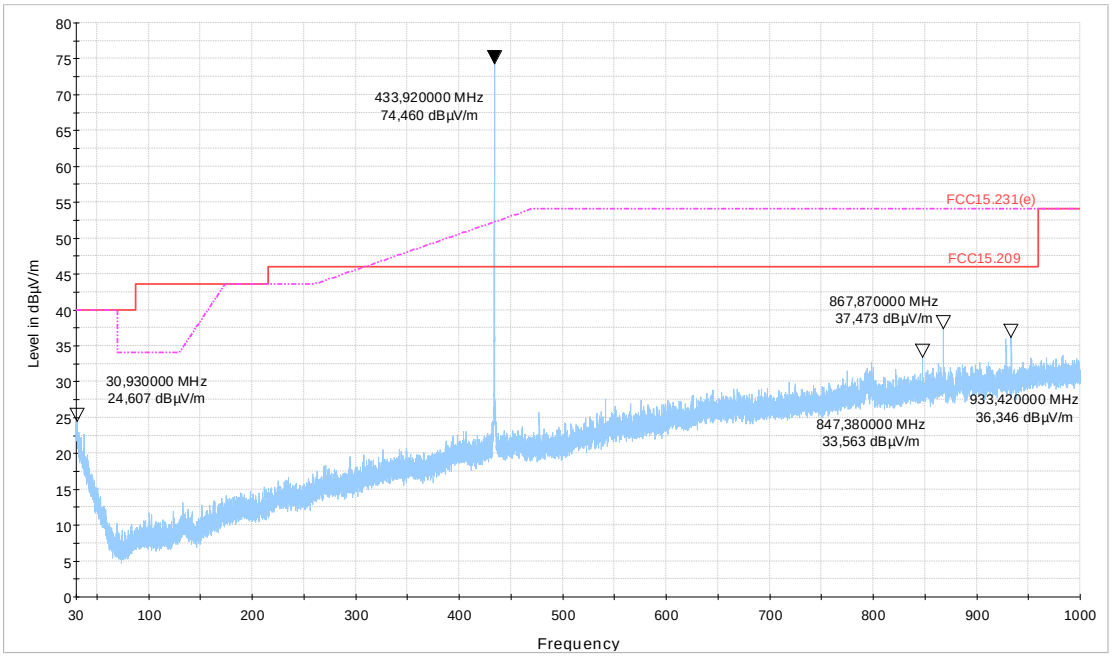
1.3. Radiated emissions in the frequency range 30 to 1000 MHz

3.11_RSE_TX_standing



Remark: wanted TX emission at 434 MHz visible on diagram, not relevant for test decision

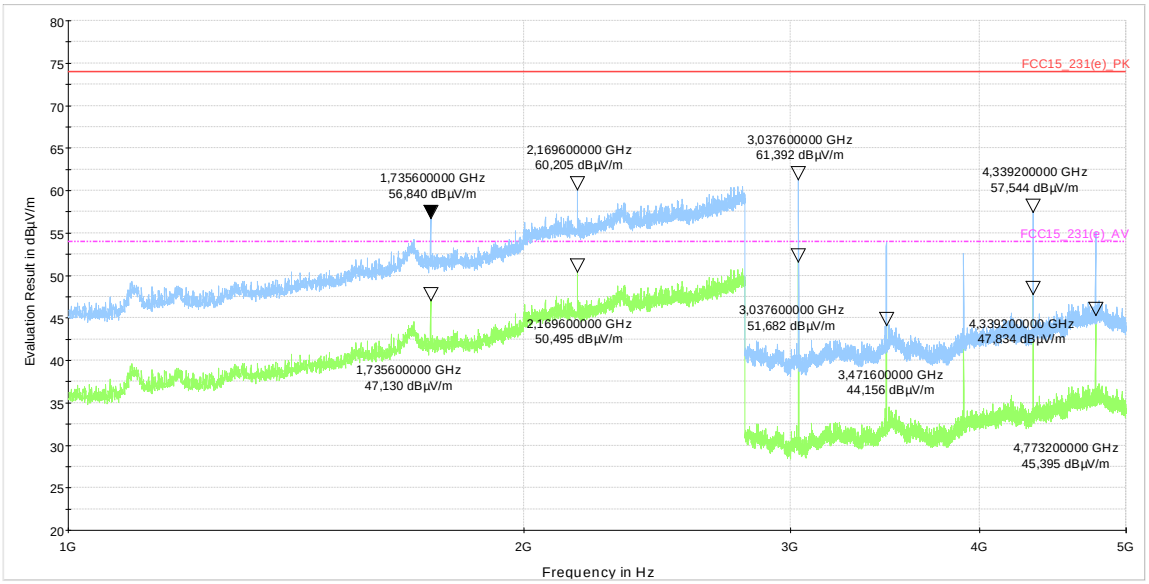
3.12_RSE_TX_lying



Remark: wanted TX emission at 434 MHz visible on diagram, not relevant for test decision

1.4. Radiated emissions in the frequency range above 1000 MHz

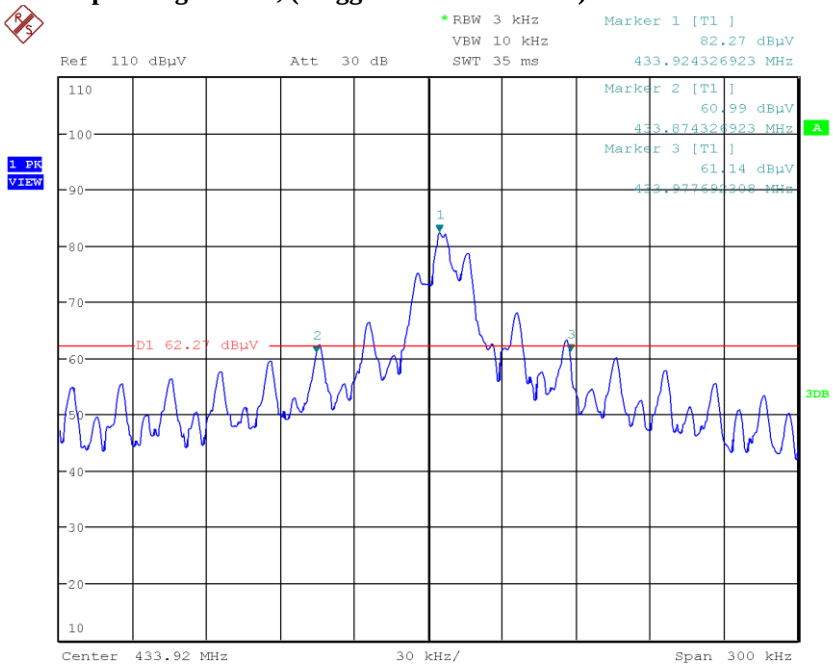
4.01_RSE_TX



Remark: Test mode (CW signal) is applied for this test. Thus the emission level measured by peak detector (blue trace) is corrected according the worst case of duty cycle by -9.71 dB. in order to get the emission level related to AVERAGE detector (green trace). See section 1.7. Duty-Cycle correction for determination of worst-case timing and corresponding correction factor calculation.

1.5. 20dB bandwidth

1.5.1. Operating mode 2, (Trigger command No.28)



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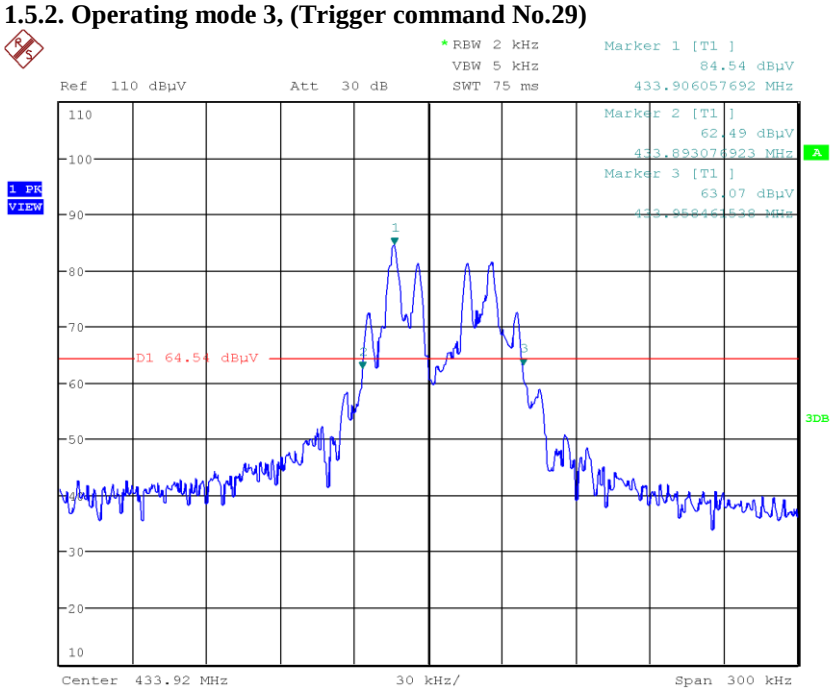
Date: 16.MAR.2020 14:25:14

1.5.2. Operating mode 3, (Trigger command No.29)



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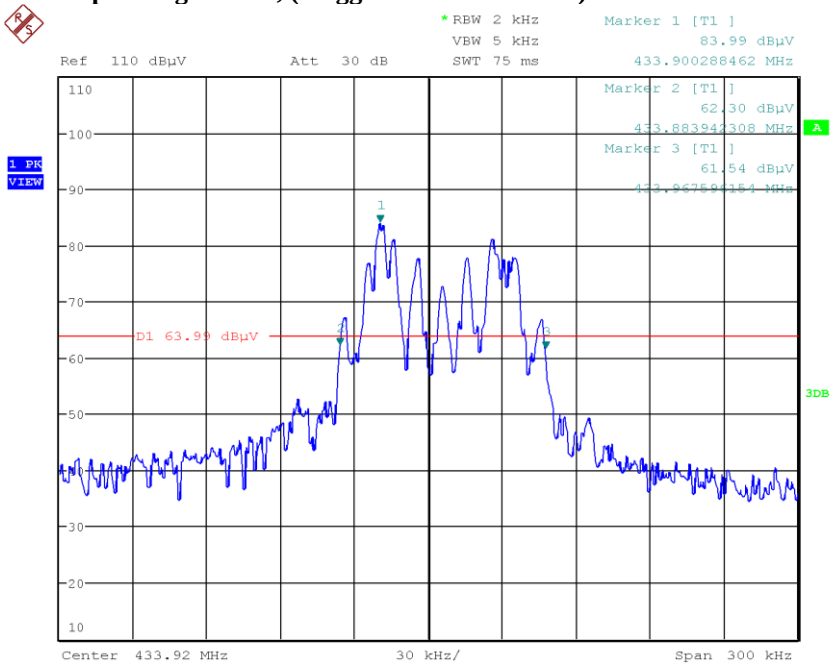
Date: 16.MAR.2020 14:31:52

1.5.3. Operating mode 4, (Trigger command No.30)



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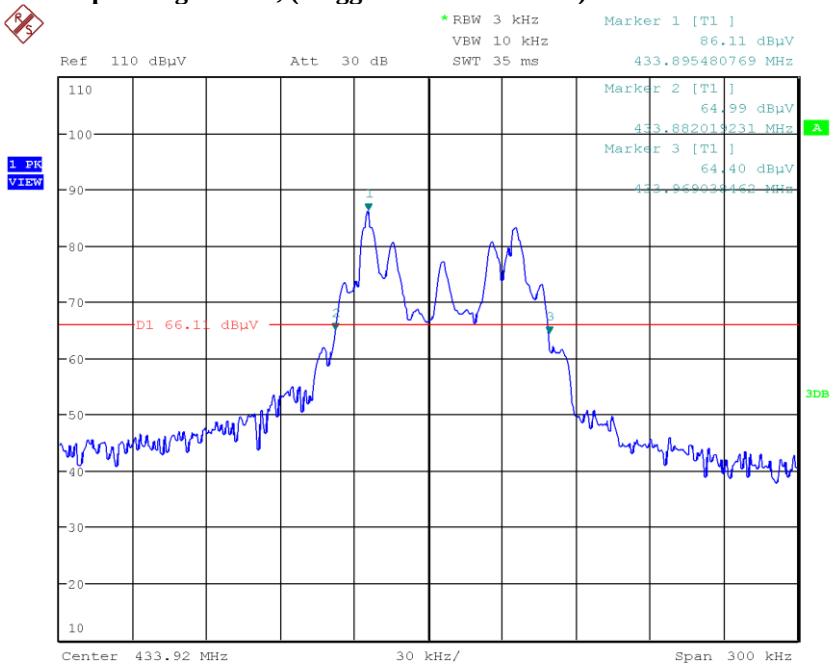
Date: 16.MAR.2020 14:36:52

1.5.4. Operating mode 5, (Trigger command No.31)



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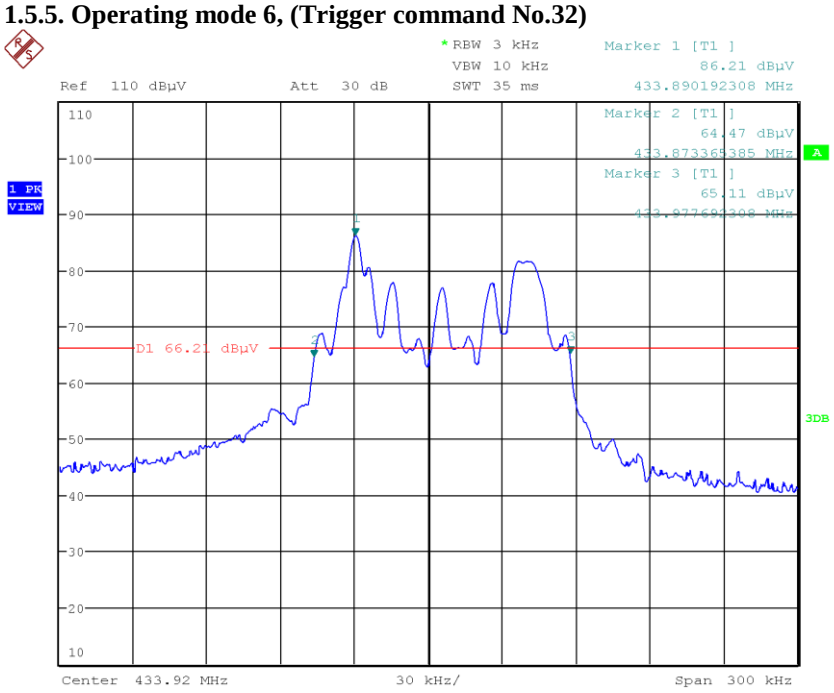
Date: 16.MAR.2020 14:46:43

1.5.5. Operating mode 6, (Trigger command No.32)



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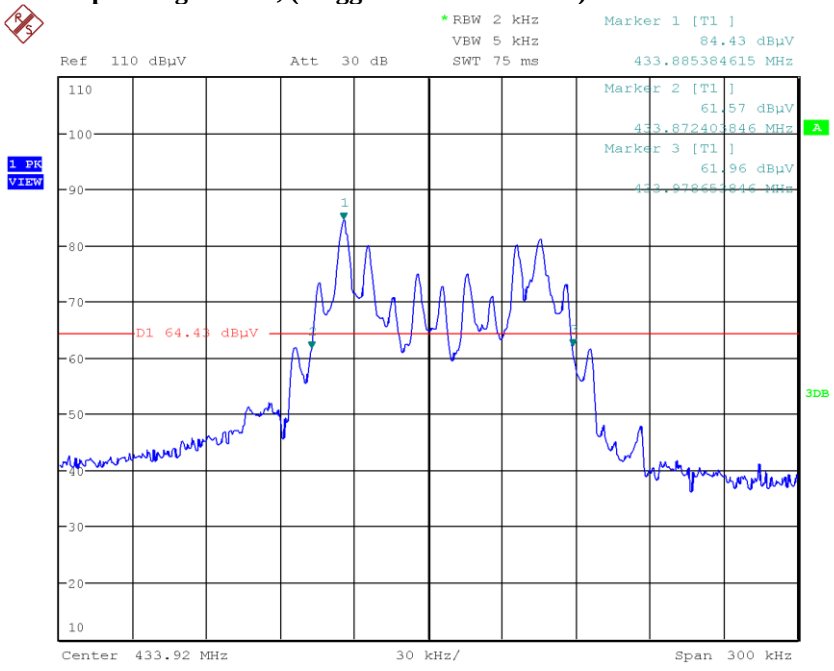
1.5.6. Operating mode 7, (Trigger command No.33)



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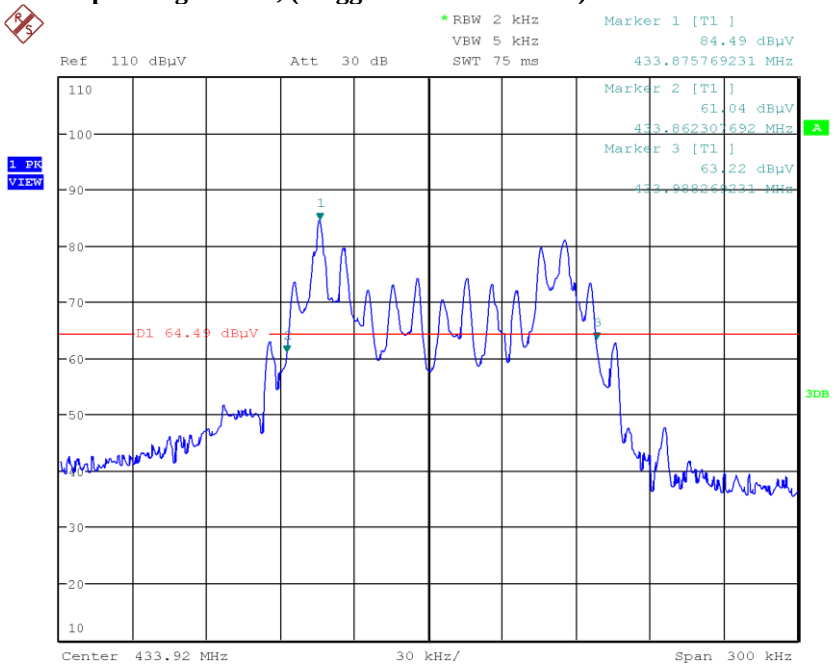
1.5.7. Operating mode 8, (Trigger command No.34)



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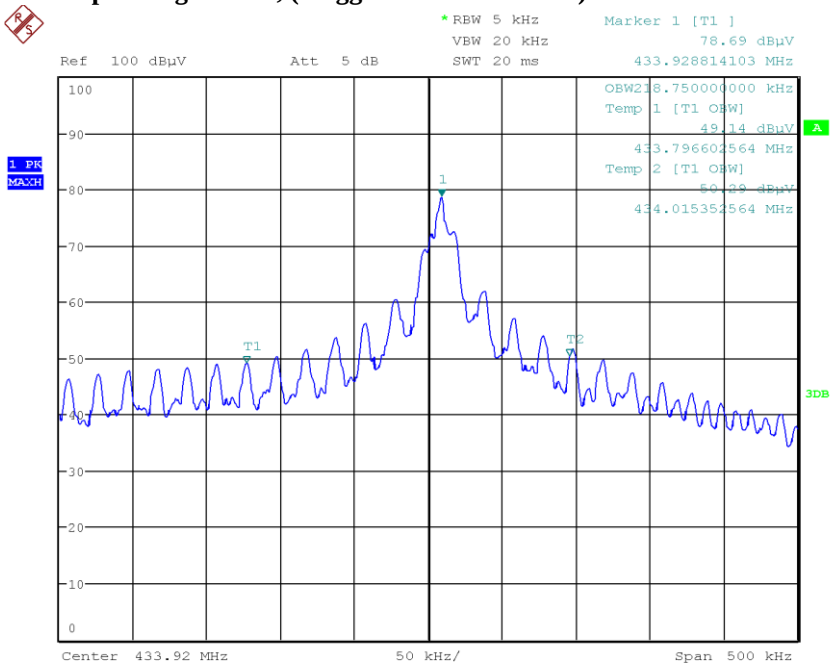
Date: 16.MAR.2020 15:10:35

1.6. 99% Occupied bandwidth

1.6.1. Operating mode 2, (Trigger command No.28)



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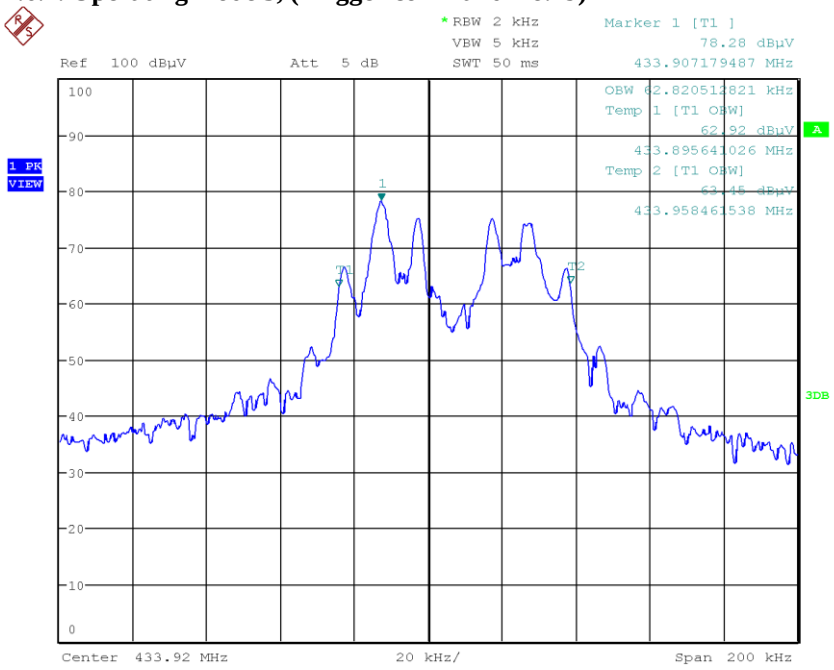
Date: 26.FEB.2020 16:50:03

1.6.2. Operating mode 3, (Trigger command No.29)



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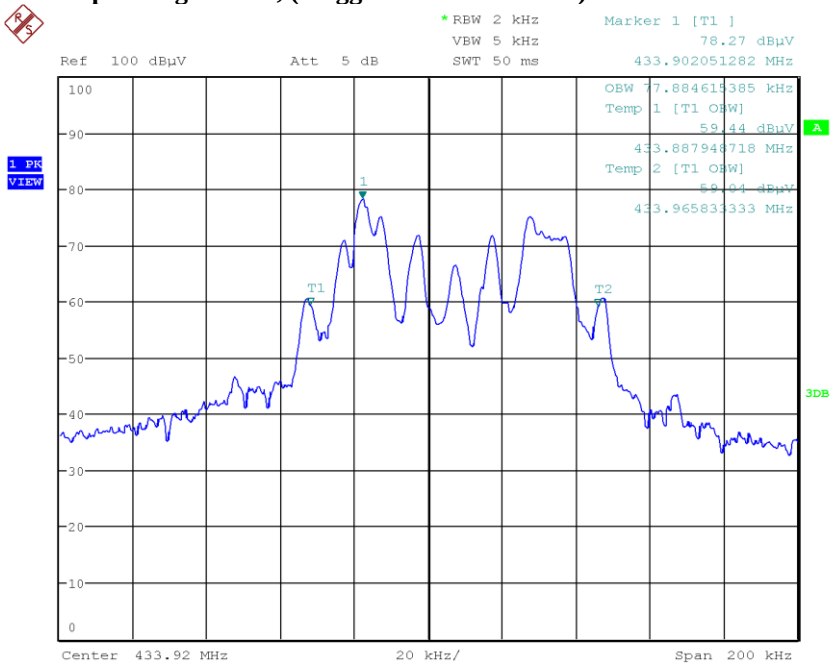
Date: 26.FEB.2020 16:56:35

1.6.3. Operating mode 4, (Trigger command No.30)



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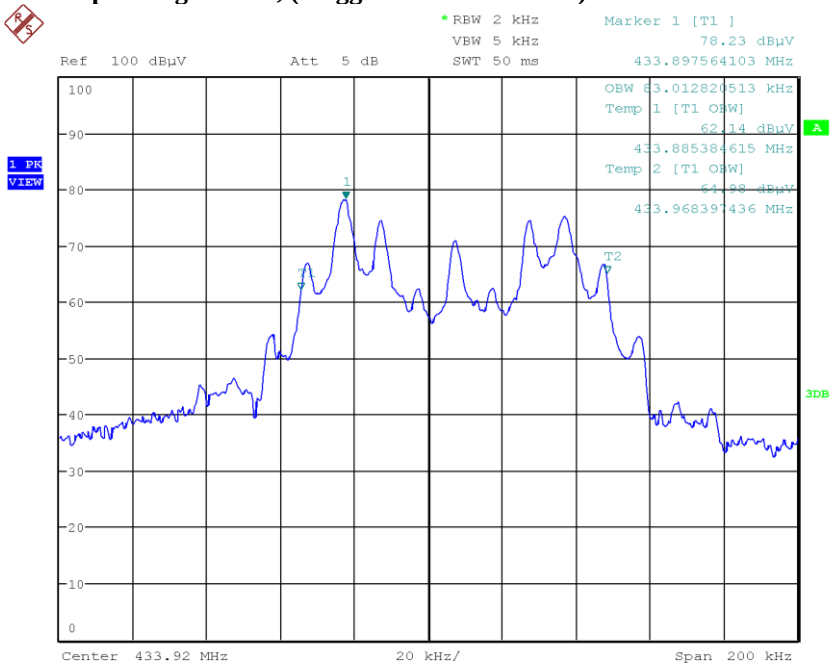
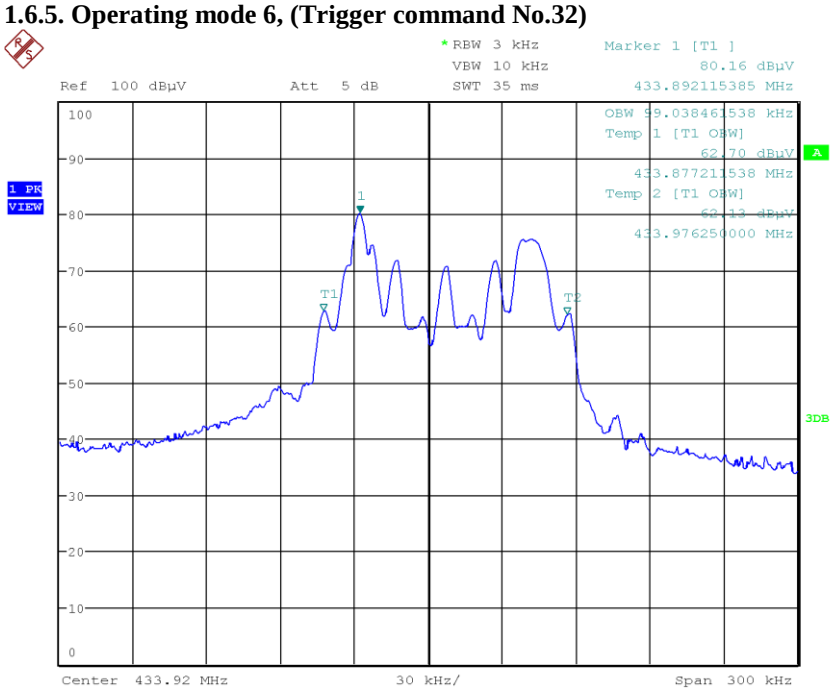
Date: 26.FEB.2020 16:59:46

1.6.4. Operating mode 5, (Trigger command No.31)



1.6.5. Operating mode 6, (Trigger command No.32)



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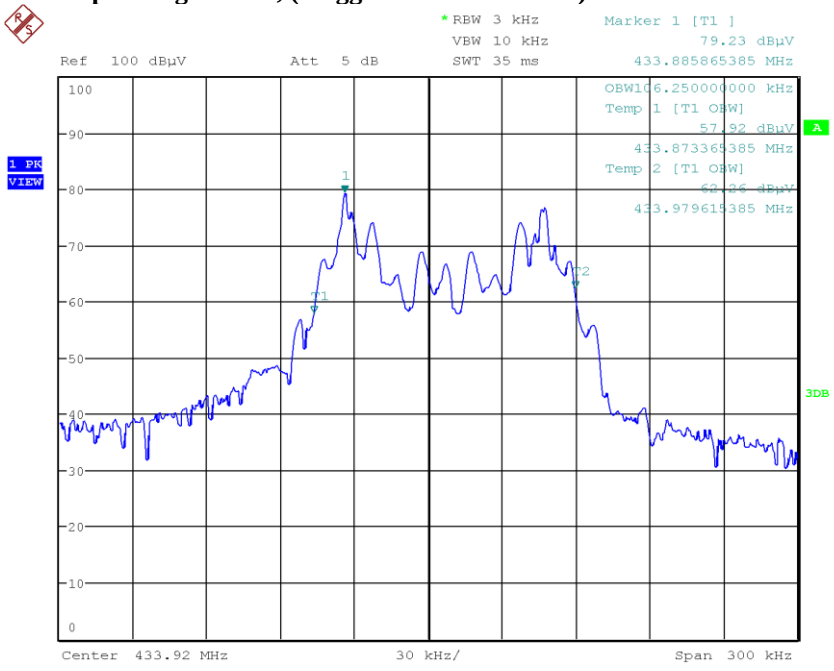
1.6.6. Operating mode 7, (Trigger command No.33)



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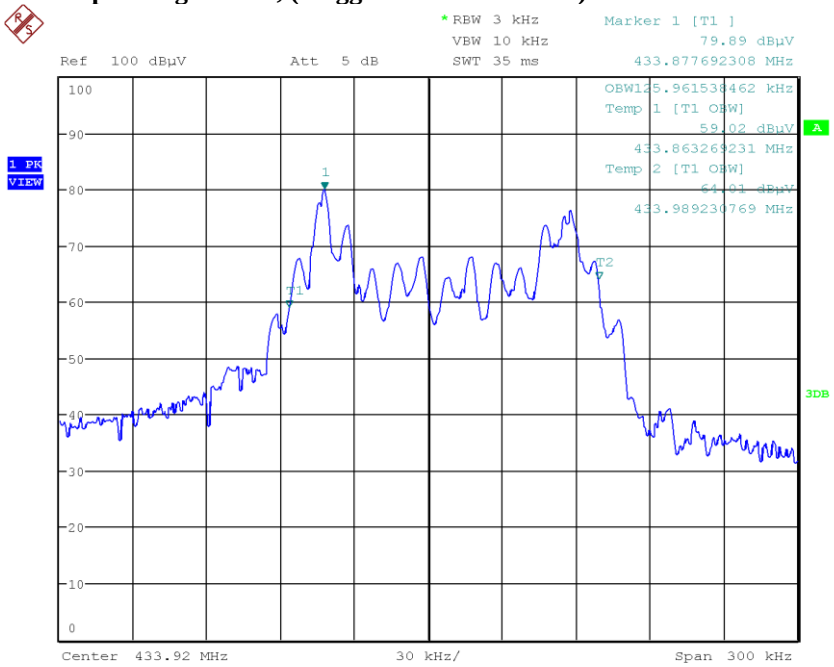
1.6.7. Operating mode 8, (Trigger command No.34)



1.7. Duty-Cycle correction

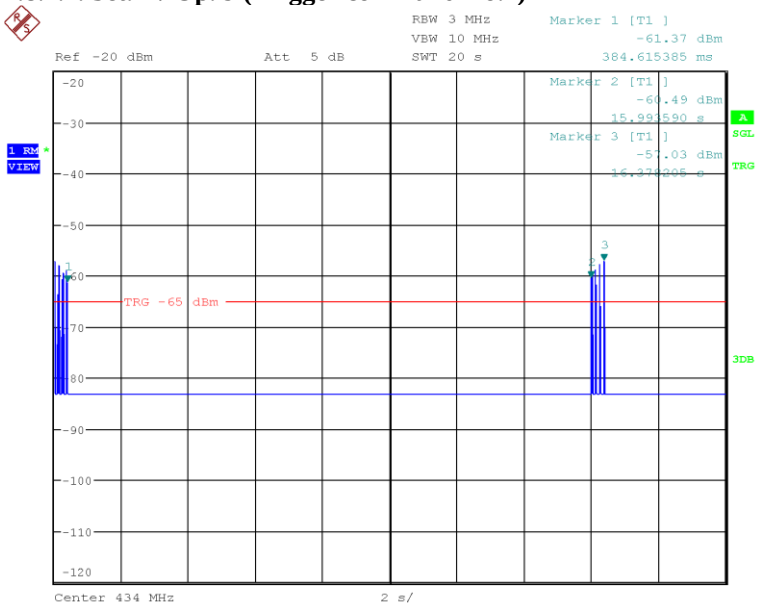
A duty-cycle Peak to AV applies since the transmitter is not 100% on during a 100 ms time unit. Pls. see below diagrams showing the behavior of the pulses and calculations performed

Worst-Case Duty-Cycle correction = -9.71 dB (section 1.8. Transmission characteristics).

1.8. Transmission characteristics

1.8.1. Duty cycle of transmission (§15.231(b)(2))

1.8.1.1. Set. 1 / Op. 9 (Trigger command No.2)



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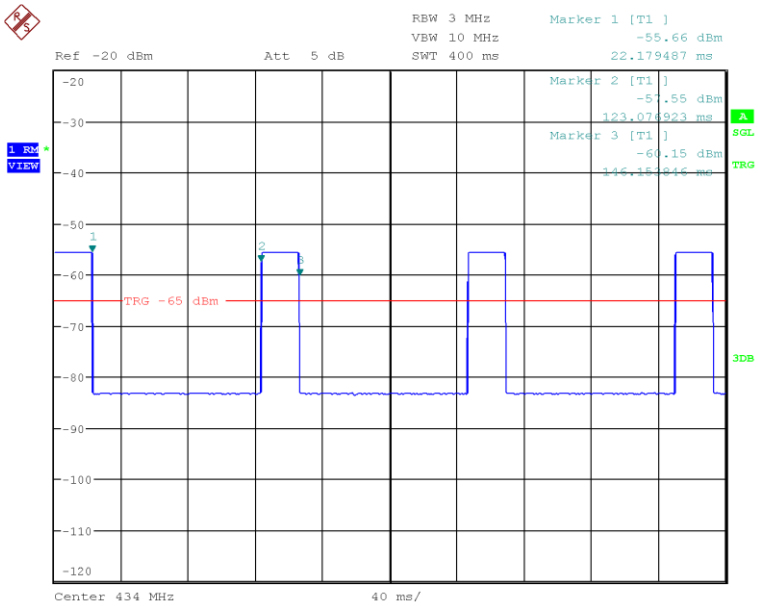
Date: 10.MAR.2020 16:09:12

Diagram 40.01a – Sweep time of 20 s

➔ One period of transmission takes 385 ms (including TX-off time + 4 TX-on pulses)



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Date: 10.MAR.2020 16:04:11

Diagram 40.01b – Sweep time of 400 ms

➔ Each pulse takes 22.7 ms in average

AVERAGE to PEAK correction calculations:

Cycle Time within 400 ms: TX_{ON}-Pulse + TX_{OFF} = 123.1 ms

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

Therefore: Duty-Cycle [dB] related to 100 ms = $20*\log_{10}$(22.7 ms / 100 ms) = -12.88 dB

For Peak to AV correction of measured field strength: -12.88 dB apply for averaging the peak emission values.

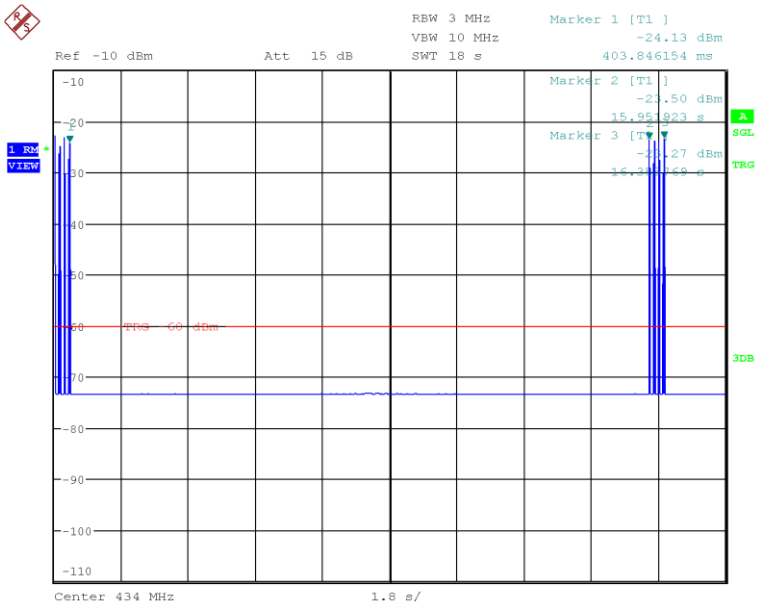
LIMITS FOR TIMING:

1. TX-on time: 385 ms < 1 second (§15.231(e)) -> pass
2. Silent period: 15.994 s - 0.385 s = 15.609 s > 11.55 s (30 * 385 ms TX-on time) > 10 s -> pass
3. Device shall show a means for automatically limiting operation:
   Automatically limiting operation after each train pulse of 385 ms TX-on time -> pass

VERDICT:

Device under Op. mode 9 (trigger command no.2) complies with the regulation.

1.8.1.2. Set. 1 / Op. 10 (Trigger command No.7)



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Date: 11.MAR.2020 11:21:17

Diagram 40.02a – Sweep time of 18 s

➔ One period of the transmission takes 404 ms (including TX-off time + 4 TX-on pulses)

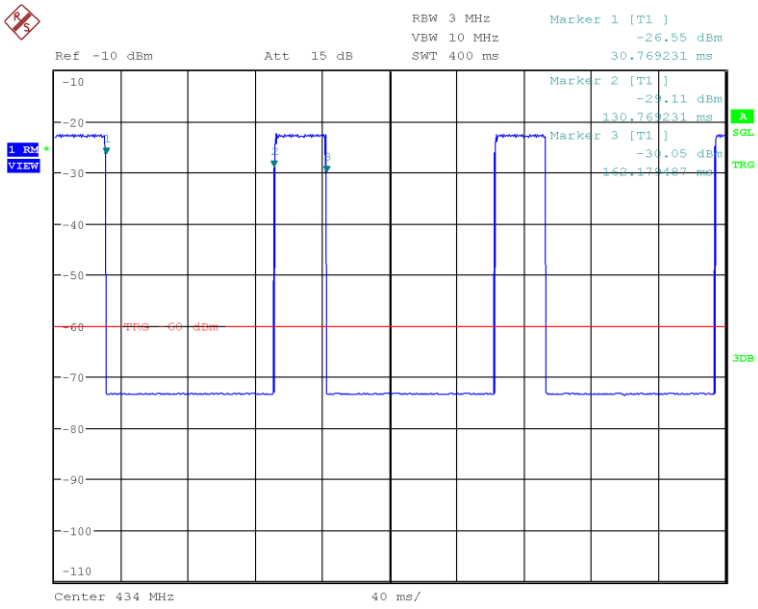


Diagram 40.01b – Sweep time of 400 ms

➔ Each pulse takes 31.1 ms in average

AVERAGE to PEAK correction calculations:

Cycle Time within 400 ms: TX_{ON}-Pulse + TX_{OFF} = 130.8 ms

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

Therefore: Duty-Cycle [dB] related to 100 ms = $20*\log_{10}(31.1\text{ ms} / 100\text{ ms})$ = -10.14 dB

For Peak to AV correction of measured field strength: -10.14 dB apply for averaging the peak emission values.

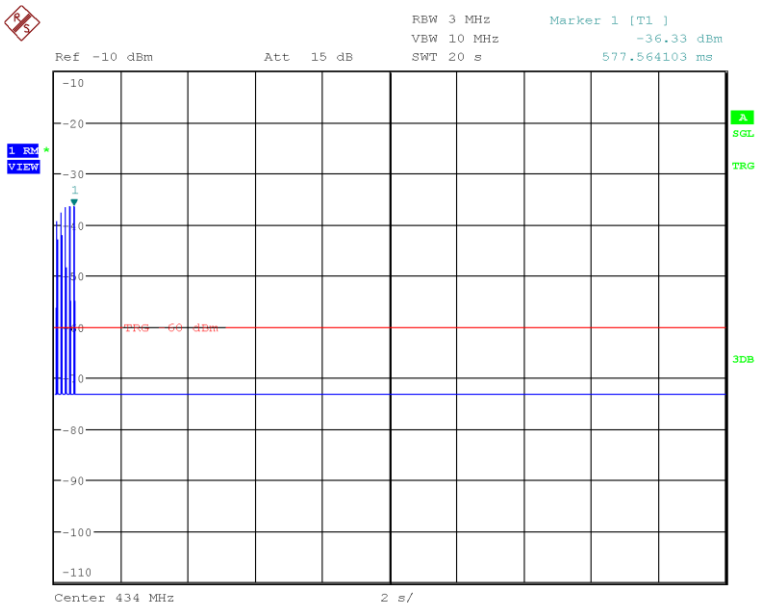
LIMITS FOR TIMING:

1. TX-on time: 404 ms < 1 second (§15.231(e)) -> pass
2. Silent period: 16.356 s - 0.404 s = 15.952 s > 12.12 s (30 * 404 ms TX-on time) > 10 s -> pass
3. Device shall show a means for automatically limiting operation:
   Automatically limiting operation after each train pulse of 404 ms TX-on time -> pass

VERDICT:

Device under Op. mode 10 (trigger command no.7) complies with the regulation.

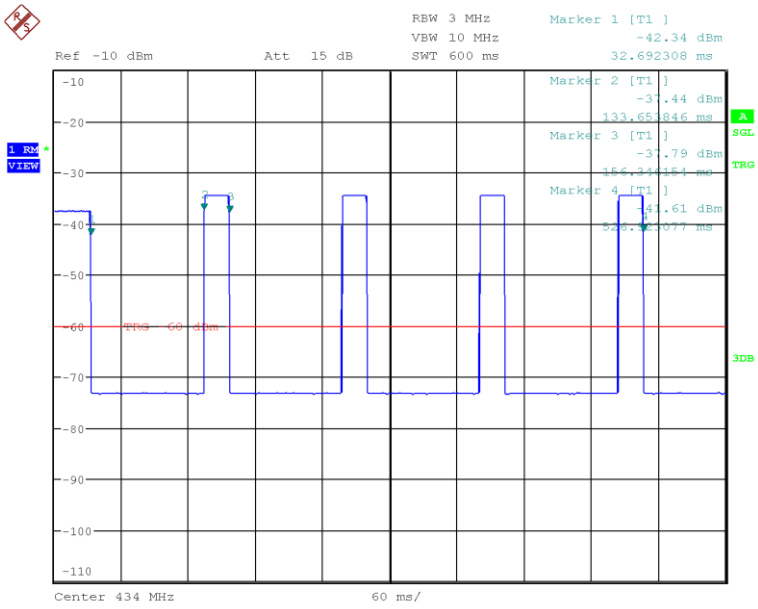
1.8.1.3. Set. 1 / Op. 11 (Trigger command No.8)



Date: 21.APR.2020 17:11:54

Diagram 40.03a – Sweep time of 20 s

➔ One non-periodic transmission takes 578 ms (including TX-off time + 4 TX-on pulses)



Date: 21.APR.2020 17:09:54

Diagram 40.03b – Sweep time of 600 ms

➔ The longest single pulse takes 32.7 ms

AVERAGE to PEAK correction calculations:

Cycle Time within 600 ms: TX_{ON}-Pulse + TX_{OFF} = 133.7 ms

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

Therefore: Duty-Cycle [dB] related to 100 ms = $20*\log_{10}(32.7 \text{ ms} / 100 \text{ ms})$ = -9.71 dB

For Peak to AV correction of measured field strength: -9.71 dB apply for averaging the peak emission values.

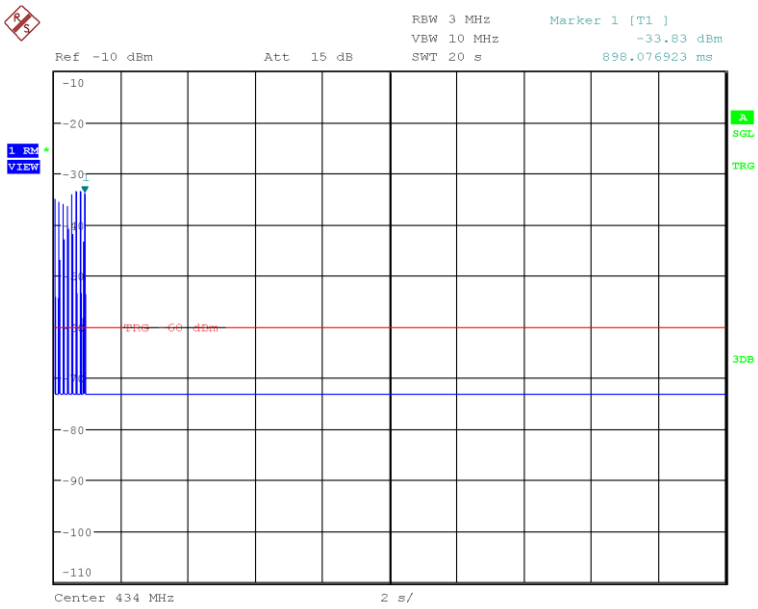
LIMITS FOR TIMING:

1. TX-on time: 578 ms < 1 second (§15.231(e)) -> pass
2. Silent period: = ∞ (Non-periodic, non-repetitive) -> pass
3. Device shall show a means for automatically limiting operation:
   Automatically limiting operation after each train pulse of 578 ms TX-on time -> pass

VERDICT:

Device under Op. mode 11 (trigger command no.8) complies with the regulation.

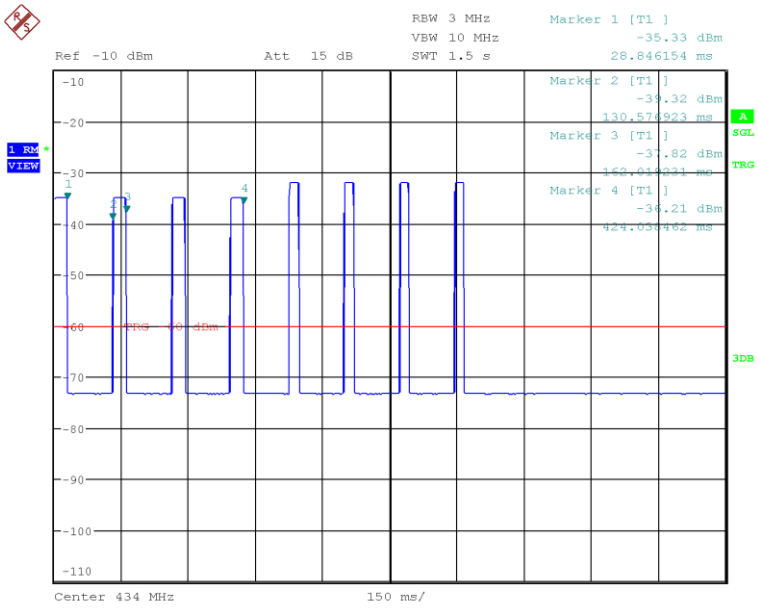
1.8.1.4. Set. 1 / Op. 12 (Trigger command No.12)



Date: 21.APR.2020 17:22:04

Diagram 40.04a – Sweep time of 20 s

➔ One non-periodic transmission takes 898 ms, containing 8 pulses (including TX-off time and TX-on time)



Date: 21.APR.2020 17:23:43

Diagram 40.04b – Sweep time of 1.5 s

➔ The longest single pulse takes 28.8 ms

AVERAGE to PEAK correction calculations:

Cycle Time within 1.5 s: TX_{ON}-Pulse + TX_{OFF} = 130.6 ms

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

Therefore: Duty-Cycle [dB] related to 100 ms = $20*\log_{10}(28.8 \text{ ms} / 100 \text{ ms})$ = -10.81 dB

For Peak to AV correction of measured field strength: -10.81 dB apply for averaging the peak emission values.

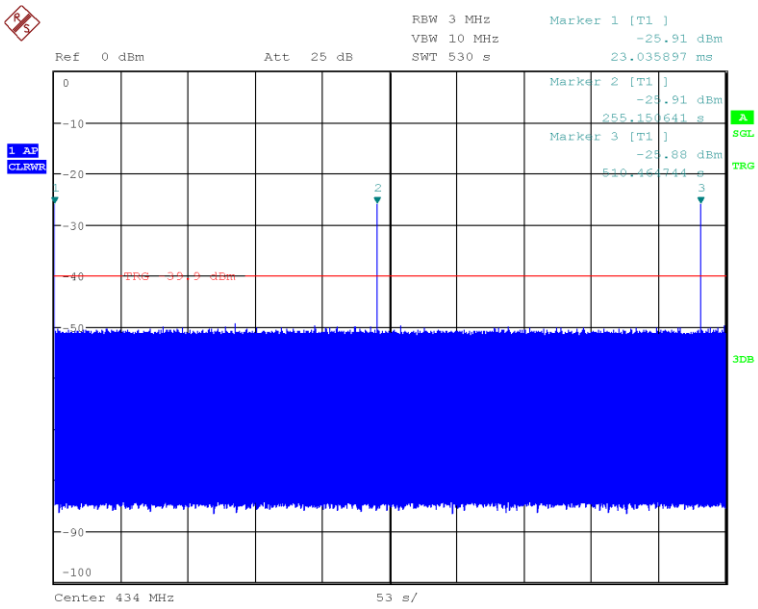
LIMITS FOR TIMING:

1. TX-on time: 898 ms < 1 second (§15.231(e)) -> pass
2. Silent period: = ∞ (Non-periodic, non-repetitive) -> pass
3. Device shall show a means for automatically limiting operation:
   Automatically limiting operation after each train pulse of 898 ms TX-on time -> pass

VERDICT:

Device under Op. mode 12 (trigger command no.12) complies with the regulation.

1.8.1.5. Set. 2 / Op. 13 (Trigger command No.17)



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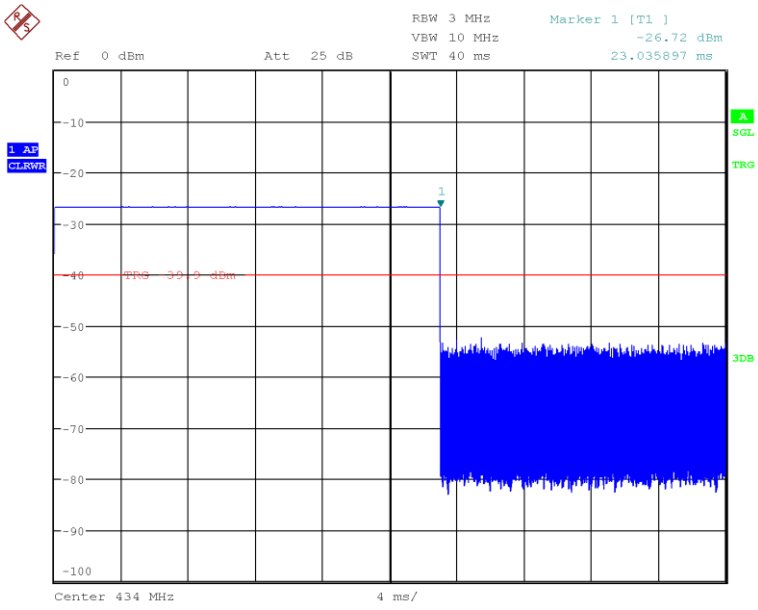
Date: 29.JUL.2020 11:37:40

Diagram 40.05a – Sweep time of 530 s

➔ One periodic transmission takes less than 1 s, containing 1 pulse



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Date: 29.JUL.2020 11:27:25

Diagram 40.05b – Sweep time of 40 ms

➔ One pulse takes 23.04 ms

AVERAGE to PEAK correction calculations:

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

Therefore: Duty-Cycle [dB] related to 100 ms = $20*\log_{10}(23.04 \text{ ms} / 100 \text{ ms}) = -12.75$ dB

For Peak to AV correction of measured field strength: -12.75 dB apply for averaging the peak emission values.

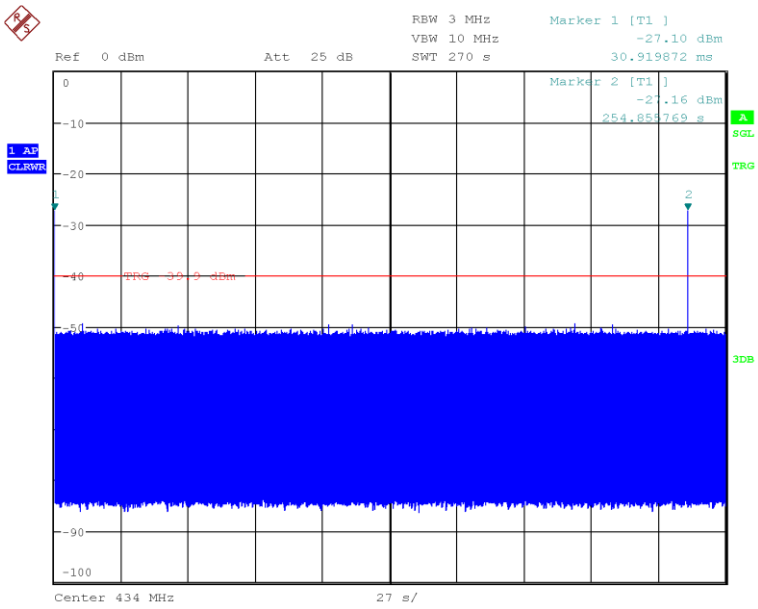
LIMITS FOR TIMING:

1. TX-on time: 23.04 ms < 1 second (§15.231(e)) -> pass
2. Silent period: 255.15 s - 0.023 s = 255.127 s > 10 s > 0.69 s (30 * 23.04 ms TX-on time) -> pass
3. Device shall show a means for automatically limiting operation:
   Automatically limiting operation after each train pulse of 23.04 ms TX-on time -> pass

VERDICT:

Device under Op. mode 13 (trigger command no.17) complies with the regulation.

1.8.1.6. Set. 2 / Op. 14 (Trigger command No.20)



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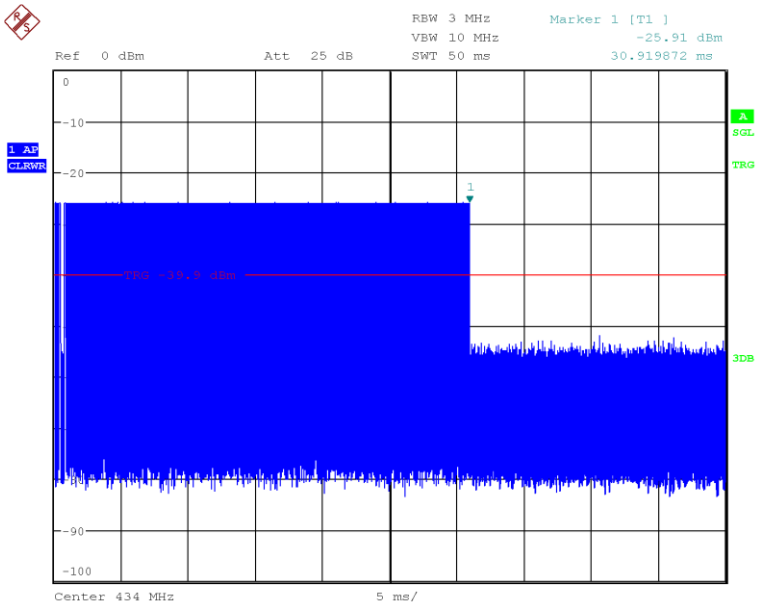
Date: 29.JUL.2020 11:45:48

Diagram 40.06a – Sweep time of 270 s

➔ One periodic transmission takes less than 1 s, containing 1 pulse



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Date: 29.JUL.2020 11:40:00

Diagram 40.06b – Sweep time of 50 ms

➔ One pulse takes 30.9 ms

AVERAGE to PEAK correction calculations:

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

Therefore: Worst case of Duty-Cycle [dB] related to 100 ms = $20*\log_{10}(31\ ms / 100\ ms) = -10.17$ dB

For Peak to AV correction of measured field strength: -10.17 dB apply for averaging the peak emission values.

LIMITS FOR TIMING:

1. TX-on time: 30.9 ms < 1 second (§15.231(e)) -> pass
2. Silent period: 254.85 s - 0.031 s = 254.819 s > 10 s > 0.93 s (30 * 30.9 ms TX-on time) -> pass
3. Device shall show a means for automatically limiting operation:
   Automatically limiting operation after each train pulse of 30.9 ms TX-on time -> pass

VERDICT:

Device under Op. mode 14 (trigger command no.20) complies with the regulation.

1.8.1.7. Conclusion about duty cycle

➔ Worst case of the duty cycle: Operating mode 11 (Trigger command No.8) with the DC-correction factor of -9.71 dB, which is **9.71 dB** in the absolute value.

END OF ANNEX 1