

7.4 Antenna Gain (calculated)

Applicability

This requirement applies to all types of DTS equipment.

Description

The antenna gain is defined as the difference between radiated peak power (Peak EIRP) subtracted by the conducted peak power of the module, given in dBi.

Limit

§15.247

(b)(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi.

Test setup: 8.2 with radiated test sample (see section 5.2), 8.4 with conducted test sample (see section 5.2)

Test Results

Mode 1	low channel	mid channel	high channel	Limit
Radiated peak power [dBm]	-3.6	-2.6	-5.7	36
Conducted peak power [dBm]	-3.1	-2.9	-2.7	30
Calculated antenna gain [dBi]	-0.5	0.3	-3.0	6

Comment:

Verdict

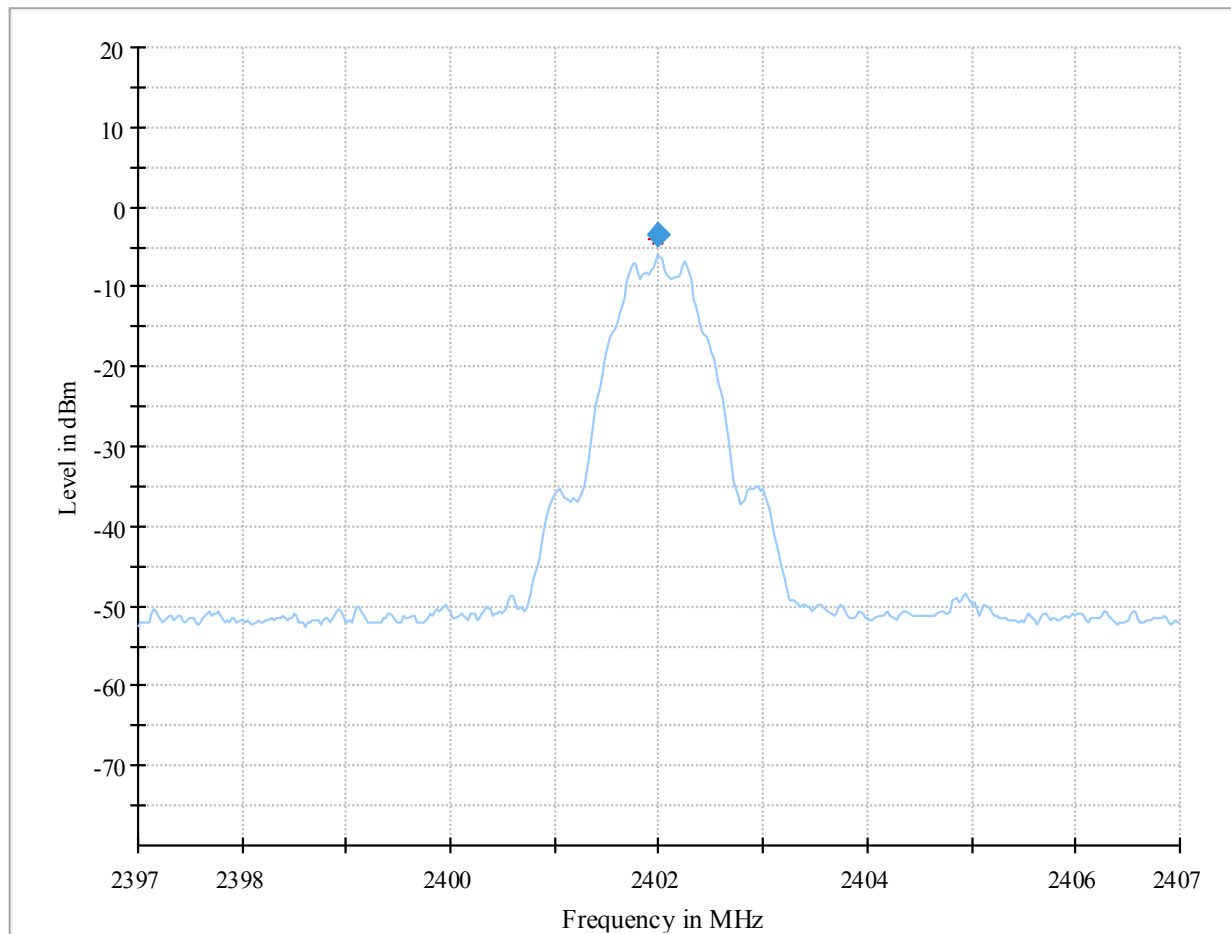
- PASS -

see next plots*

*description of line and marker for all radiated Peak Power measurements:

-  positive Peak (Max Hold) trace during pre-scan
-  Max Peak value
-  final Quasi Peak value

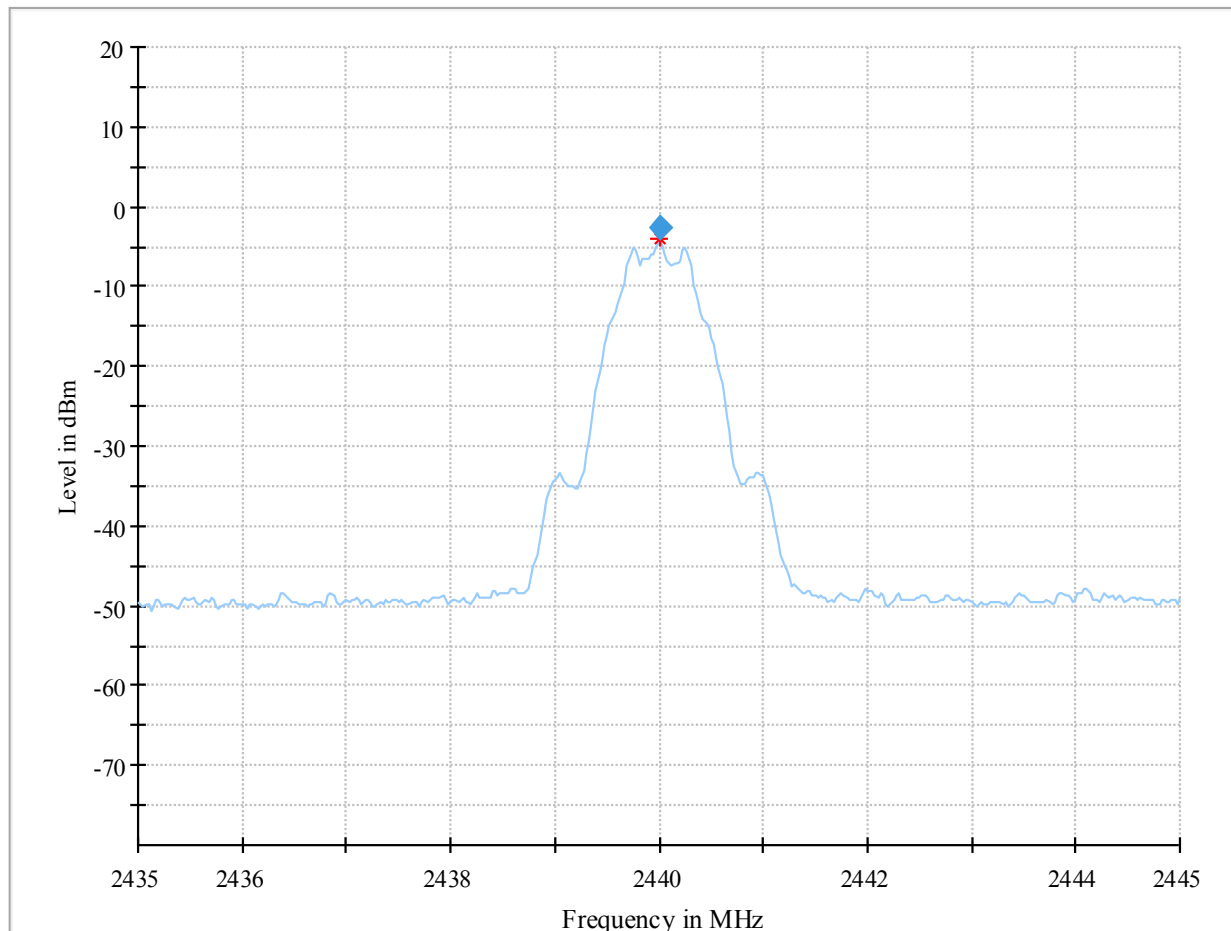
Plot 10: Mode 1, Peak EIRP, low channel



Final_Result

Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2402.000000	-3.60	---	---	100.0	1000.000	150.0	H	12.0	-62.2

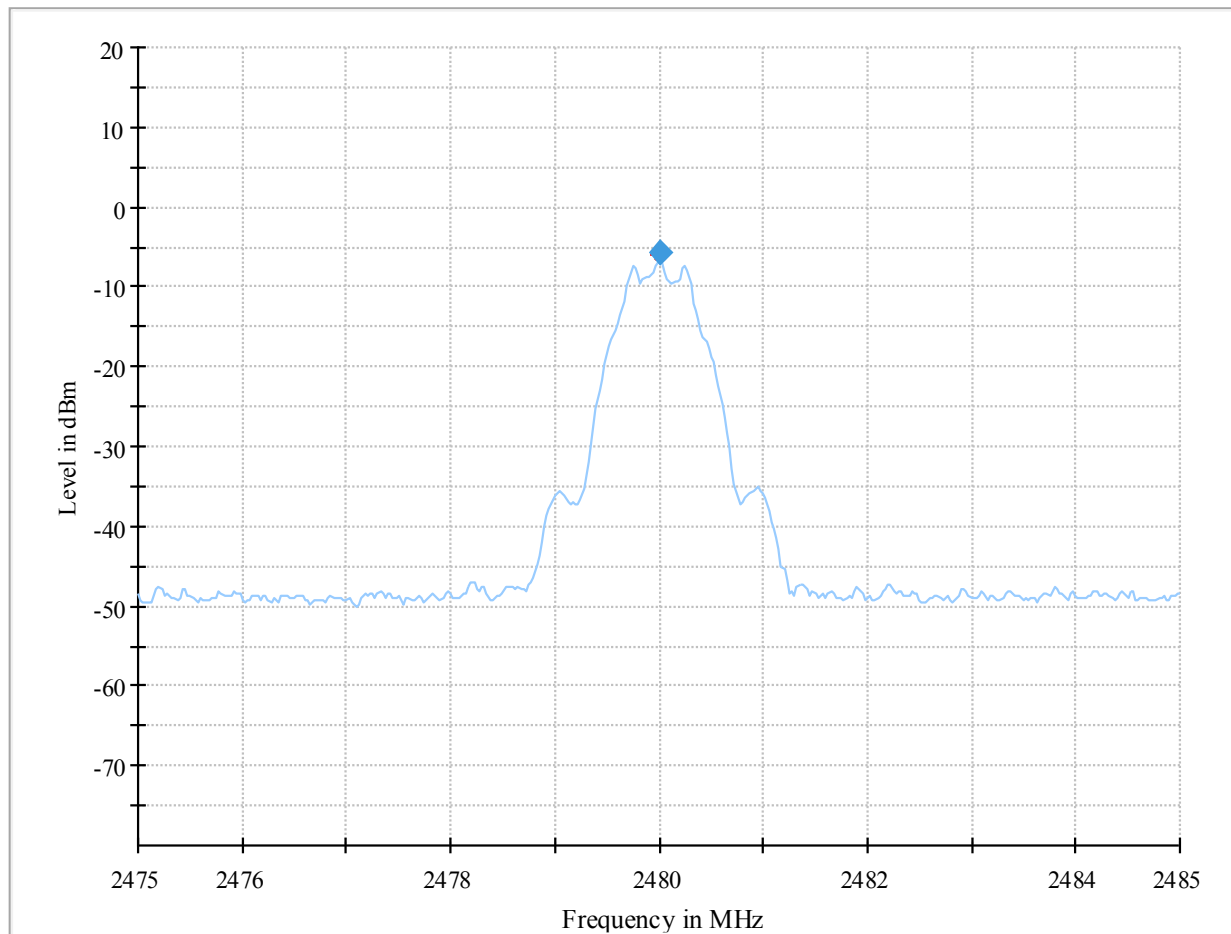
Plot 11: Mode 1, Peak EIRP, mid channel



Final_Result

Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2440.000000	-2.60	---	---	100.0	1000.000	150.0	H	7.0	-61.9

Plot 12: Mode 1, Peak EIRP, high channel



Final_Result

Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2480.000000	-5.70	---	---	100.0	1000.000	150.0	V	258.0	-61.6

7.5 Peak Power Spectral Density (PSD)

Applicability

This requirement applies to all types of DTS equipment.

Description

The Power Spectral Density (PSD) is defined as the conducted peak power spectral density in a 3 kHz bandwidth during any time of continuous transmission.

Limits

§15.247

(e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

Test procedure

ANSI C63.10, 11.10.2

The following procedure shall be used if maximum peak conducted output power was used to determine compliance, and it is optional if the maximum conducted (average) output power was used to determine compliance:

- Set analyzer center frequency to DTS channel center frequency.
- Set the span to 1.5 times the DTS bandwidth.
- Set the RBW to $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- Set the VBW $\geq [3 \times \text{RBW}]$.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level within the RBW.
- If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat.

Test setup: 8.4 with conducted test sample (see section 5.2)

Test Results

EUT Mode	Peak Power Spectral Density [dBm / 3 kHz]			Limit [dBm / 3 kHz]
	low channel	mid channel	high channel	
Mode 1	-9.6	-9.4	-9.2	8

Comment:

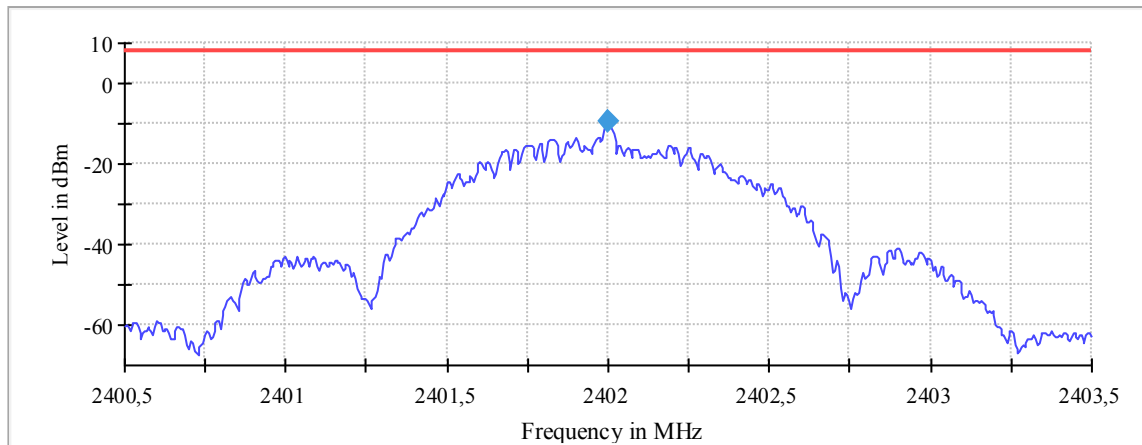
Verdict

- PASS -

see next plots

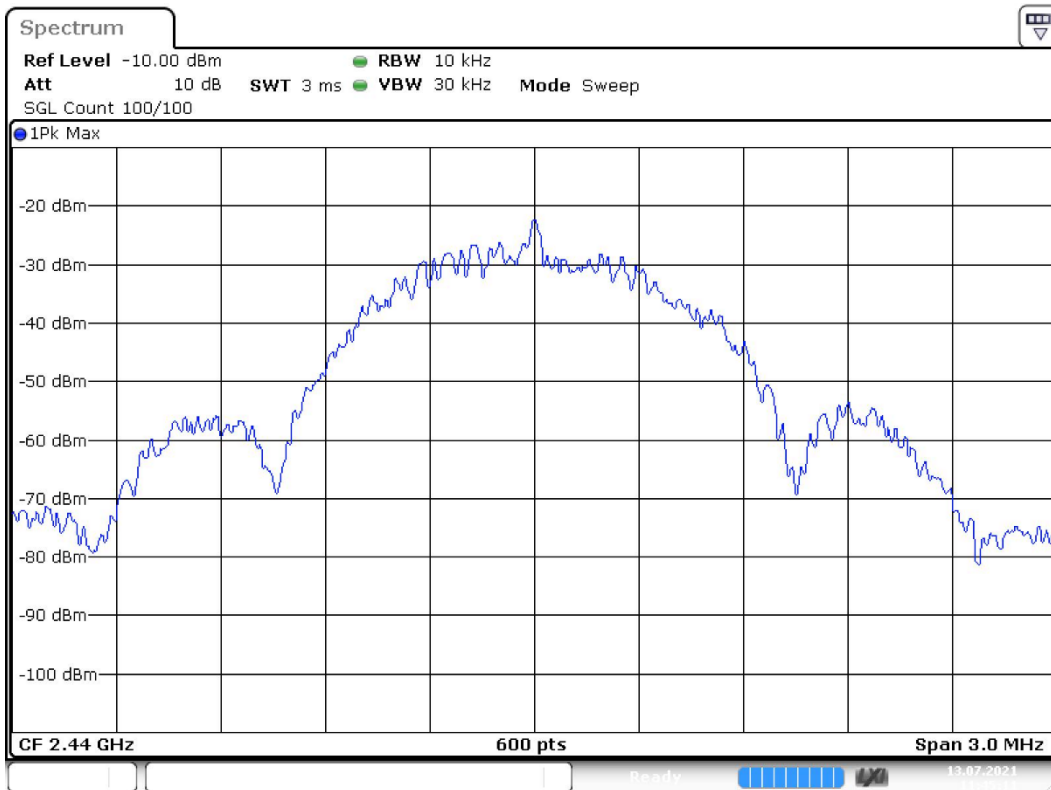
Plot 13: Mode 1, Peak PSD, low channel

Peak Power Spectral Density



— Limit — Sum Level ◆ PSD

DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2402.000000	2401.997500	-9.563	8.0	PASS



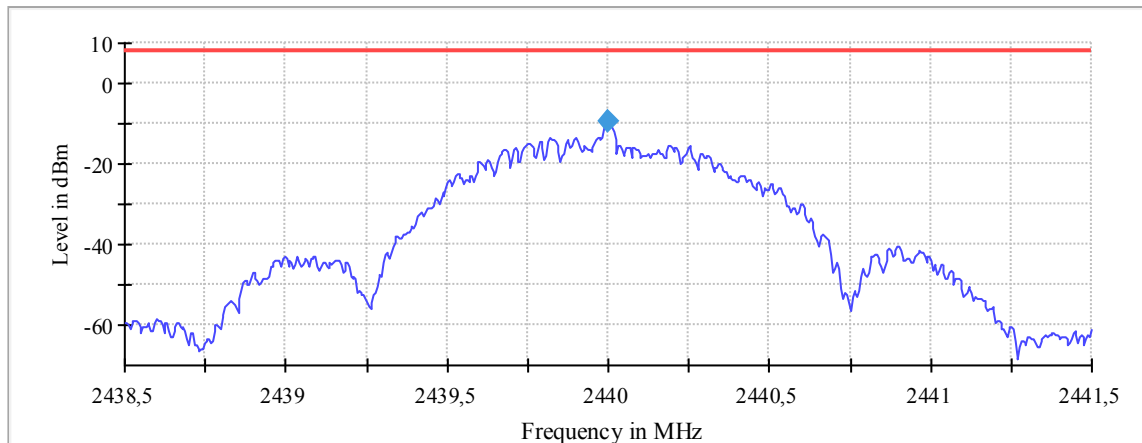
Date: 13.JUL.2021 11:45:11

Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.43850 GHz	2.43850 GHz
Stop Frequency	2.44150 GHz	2.44150 GHz
Span	3.000 MHz	3.000 MHz
RBW	10.000 kHz	<= 10.000 kHz
VBW	30.000 kHz	>= 30.000 kHz
SweepPoints	600	~ 600
SweepTime	3.000 ms	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	Sweep	Sweep
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	3 / max. 150	max. 150
Stable	2 / 2	2
Max Stable Difference	0.31 dB	0.50 dB

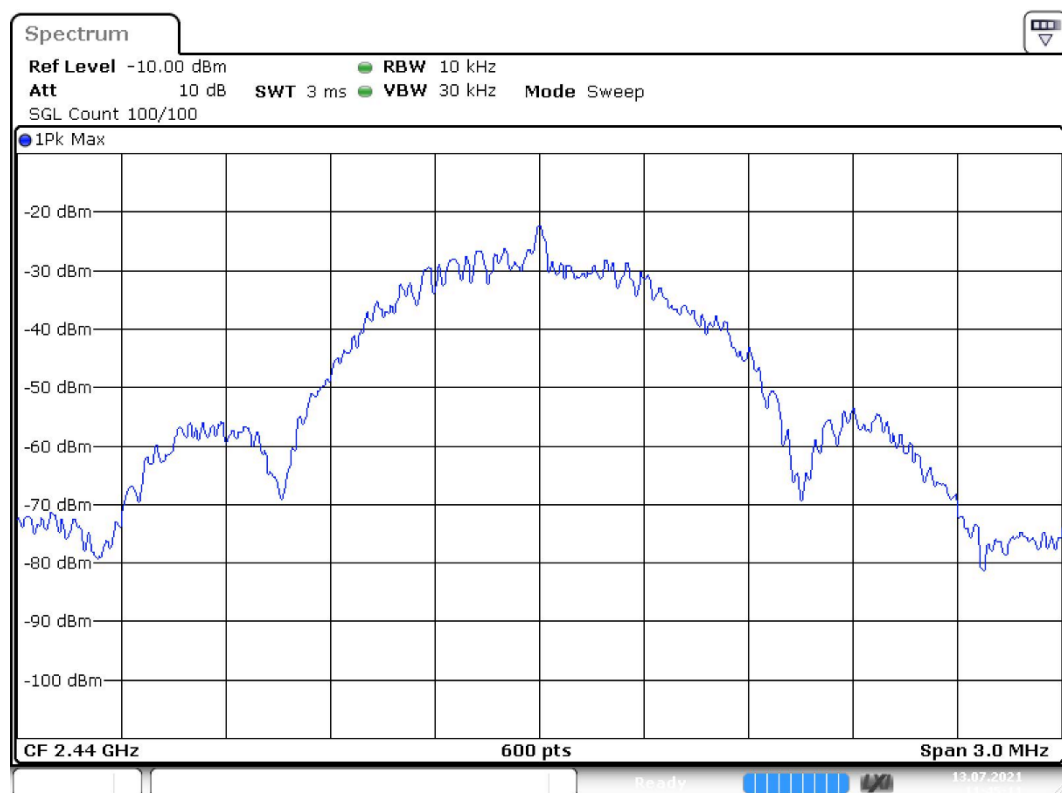
Plot 14: Mode 1, Peak PSD, mid channel

Peak Power Spectral Density



— Limit — Sum Level ◆ PSD

DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2440.000000	2439.997500	-9.403	8.0	PASS



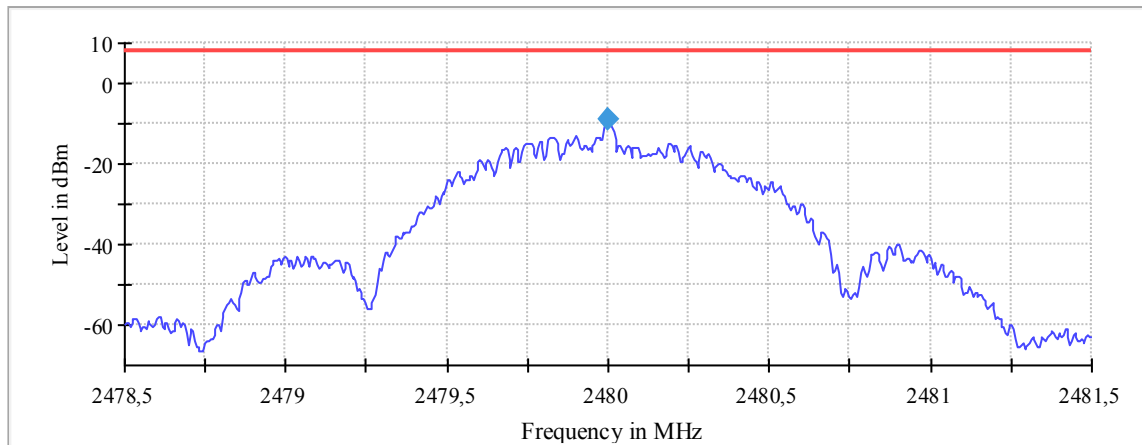
Date: 13.JUL.2021 11:45:11

Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.43850 GHz	2.43850 GHz
Stop Frequency	2.44150 GHz	2.44150 GHz
Span	3.000 MHz	3.000 MHz
RBW	10.000 kHz	<= 10.000 kHz
VBW	30.000 kHz	>= 30.000 kHz
SweepPoints	600	~ 600
SweepTime	3.000 ms	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	Sweep	Sweep
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	3 / max. 150	max. 150
Stable	2 / 2	2
Max Stable Difference	0.31 dB	0.50 dB

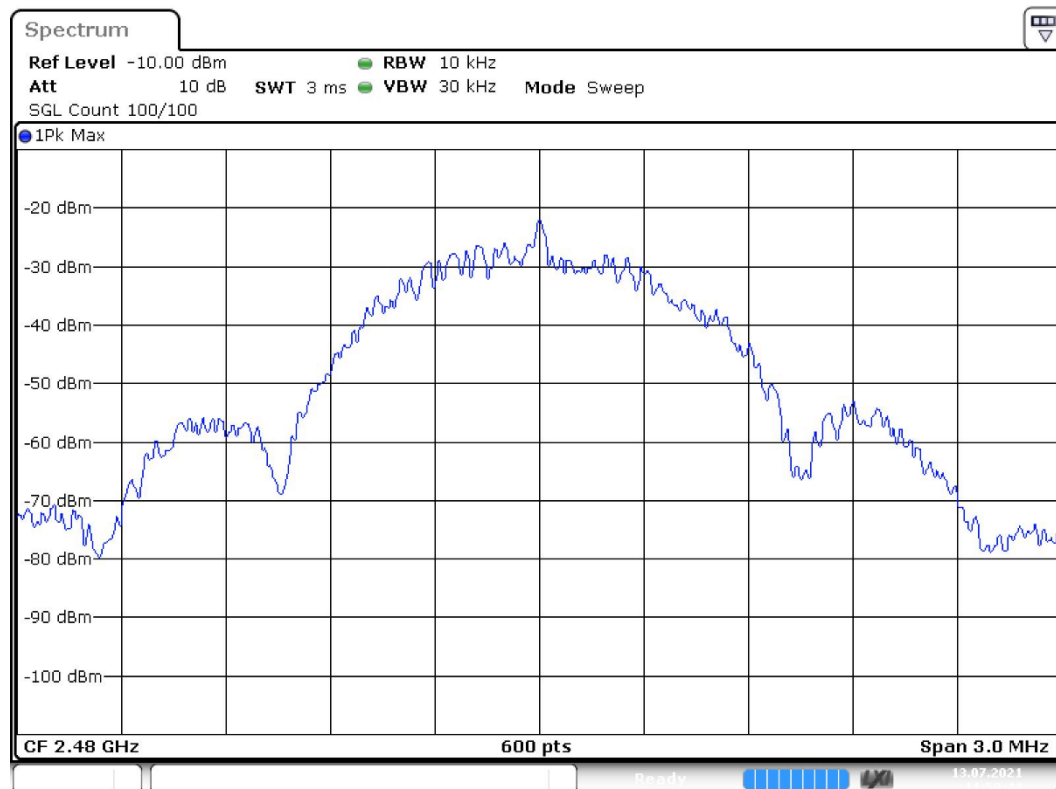
Plot 15: Mode 1, Peak PSD, high channel

Peak Power Spectral Density



— Limit — Sum Level ◆ PSD

DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2480.000000	2479.997500	-9.210	8.0	PASS



Date: 13. JUL. 2021 11:50:45

Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.47850 GHz	2.47850 GHz
Stop Frequency	2.48150 GHz	2.48150 GHz
Span	3.000 MHz	3.000 MHz
RBW	10.000 kHz	<= 10.000 kHz
VBW	30.000 kHz	>= 30.000 kHz
SweepPoints	600	~ 600
SweepTime	3.000 ms	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	Sweep	Sweep
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	4 / max. 150	max. 150
Stable	2 / 2	2
Max Stable Difference	0.13 dB	0.50 dB

7.6 Band Edge Compliance (BEC), conducted

Applicability

This requirement applies to all types of DTS equipment.

Description

Emissions within a restricted band and within 2 MHz of an authorized band edge may be measured using either the marker-delta method (ANSI C63.10, 6.10.6) or the integration method (ANSI C63.20, 11.13.3), provided that the DTS bandwidth (or EBW) edge falls within 2 MHz of the band edge. Otherwise, all unwanted emissions measurements shall be performed using the standard methods.

Limits

§15.247

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator 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, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. Attenuation below the general limits specified in §15.209(a) is not required.

Test procedure

ANSI C63.10, 11.11

Reference level measurement:

Establish a reference level by using the following procedure:

- Set instrument center frequency to DTS channel center frequency.
 - Set the span to ≥ 1.5 times the DTS bandwidth.
 - Set the RBW = 100 kHz.
 - Set the VBW $\geq [3 \times \text{RBW}]$.
 - Detector = peak.
 - Sweep time = auto couple.
 - Trace mode = max hold.
 - Allow trace to fully stabilize.
 - Use the peak marker function to determine the maximum PSD level.
- Note that the channel found to contain the maximum PSD level can be used to establish the reference level.

Emission level measurement:

Establish an emission level by using the following procedure:

- Set the center frequency and span to encompass frequency range to be measured.
- Set the RBW = 100 kHz.
- Set the VBW $\geq [3 \times \text{RBW}]$.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level.

Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) is attenuated by at least the minimum requirements as specified (≥ 20 dBc).

The marker-delta method, as described in ANSI C63.10, 6.10.6 can be used to perform measurements of the radiated unwanted emissions level at the band-edges provided that the 99 % OBW of the fundamental emission is within 2 MHz of the authorized band edge.

Test setup: 8.4 with conducted test sample (see section 5.2)

Test results

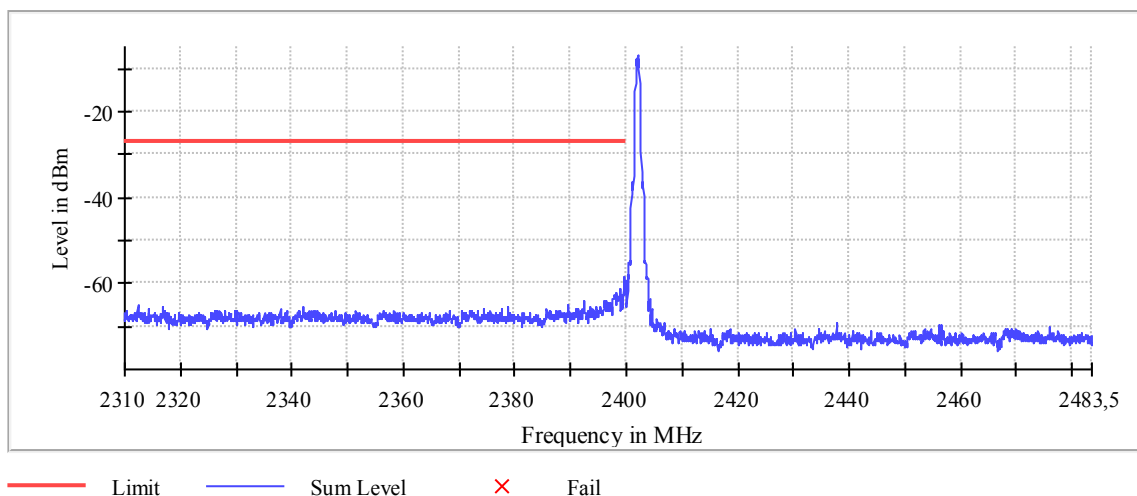
BEC	low channel [dBc]	high channel [dBc]	Limit [dBc]
Mode 1	> 50	> 55	≥ 20

Comment:	---
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Verdict	- PASS -	see next plots
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Plot 16: Mode 1, BEC, low channel

Band Edge



Result

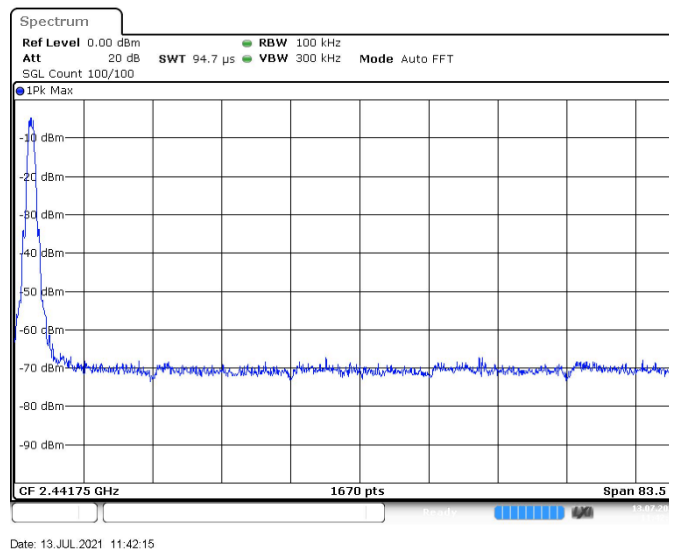
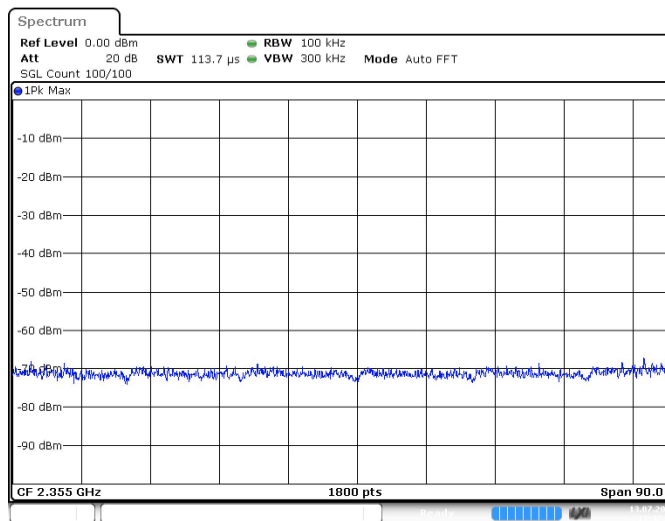
DUT Frequency (MHz)	Result
2402.000000	PASS

Inband Peak

Frequency (MHz)	Level (dBm)
2402.025000	-6.9

Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2399.625000	-58.3	31.4	-26.9	PASS
2399.575000	-58.5	31.6	-26.9	PASS
2399.675000	-59.1	32.2	-26.9	PASS
2399.925000	-59.3	32.4	-26.9	PASS
2399.975000	-59.5	32.6	-26.9	PASS
2399.875000	-59.5	32.6	-26.9	PASS
2399.525000	-59.9	33.0	-26.9	PASS
2399.725000	-60.6	33.7	-26.9	PASS
2399.825000	-60.8	33.8	-26.9	PASS
2399.475000	-61.0	34.1	-26.9	PASS
2398.925000	-61.2	34.3	-26.9	PASS
2398.875000	-61.2	34.3	-26.9	PASS
2398.825000	-61.8	34.9	-26.9	PASS
2398.975000	-62.0	35.1	-26.9	PASS
2398.275000	-62.3	35.3	-26.9	PASS



Measurement 1

Setting	Instrument Value	Target Value
Start Frequency	2.31000 GHz	2.31000 GHz
Stop Frequency	2.40000 GHz	2.40000 GHz
Span	90.000 MHz	90.000 MHz
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	1800	~ 1800
SweepTime	113.672 µs	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	4 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.00 dB	0.50 dB

Measurement 2

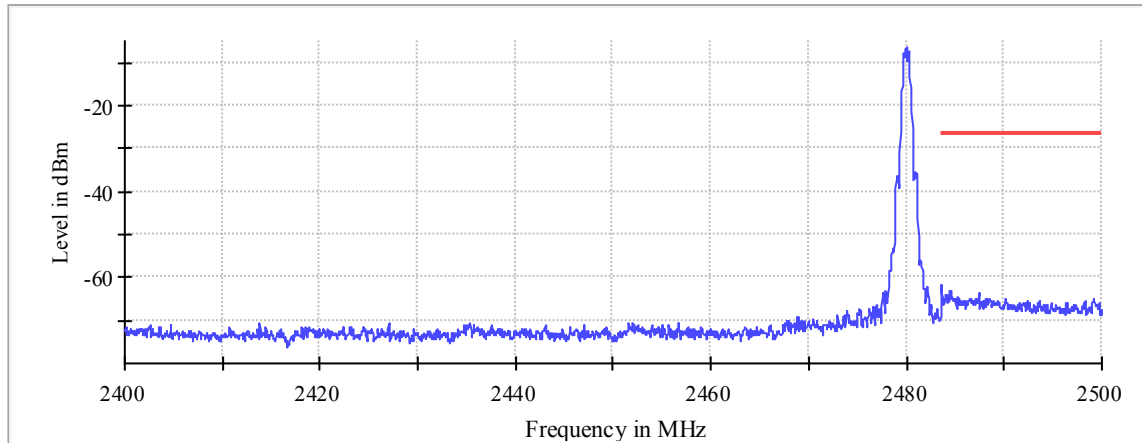
Setting	Instrument Value	Target Value
Start Frequency	2.40000 GHz	2.40000 GHz
Stop Frequency	2.48350 GHz	2.48350 GHz
Span	83.500 MHz	83.500 MHz
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	1670	~ 1670
SweepTime	94.727 µs	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace

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Stablevalue	0.50 dB	0.50 dB
Run	6 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.18 dB	0.50 dB

Plot 17: Mode 1, BEC, high channel

Band Edge



— Limit — Sum Level × Fail

Result

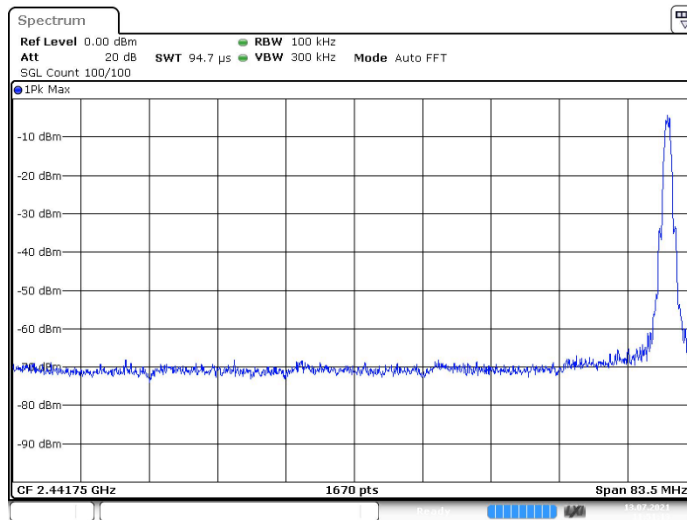
DUT Frequency (MHz)	Result
2480.000000	PASS

Inband Peak

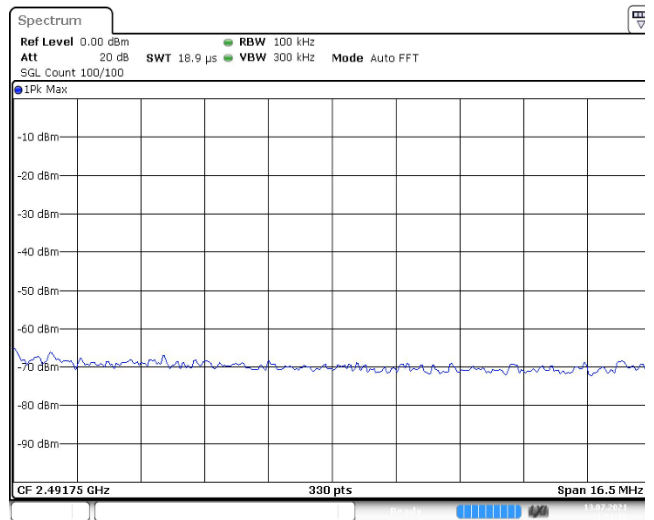
Frequency (MHz)	Level (dBm)
2480.025000	-6.6

Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2483.525000	-61.9	35.3	-26.6	PASS
2483.575000	-62.0	35.3	-26.6	PASS
2483.625000	-62.8	36.1	-26.6	PASS
2484.475000	-62.9	36.3	-26.6	PASS
2484.525000	-63.0	36.4	-26.6	PASS
2484.575000	-63.7	37.1	-26.6	PASS
2483.675000	-63.7	37.1	-26.6	PASS
2487.425000	-63.7	37.1	-26.6	PASS
2484.425000	-63.8	37.1	-26.6	PASS
2487.375000	-63.9	37.2	-26.6	PASS
2484.175000	-64.0	37.3	-26.6	PASS
2484.125000	-64.1	37.5	-26.6	PASS
2484.075000	-64.3	37.6	-26.6	PASS
2485.275000	-64.5	37.9	-26.6	PASS
2484.225000	-64.6	38.0	-26.6	PASS



Date: 13 JUL 2021 11:51:14



Date: 13 JUL 2021 11:51:18

Measurement 1

Setting	Instrument Value	Target Value
Start Frequency	2.40000 GHz	2.40000 GHz
Stop Frequency	2.48350 GHz	2.48350 GHz
Span	83.500 MHz	83.500 MHz
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	1670	~ 1670
SweepTime	94.727 μ s	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	5 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.07 dB	0.50 dB

Measurement 2

Setting	Instrument Value	Target Value
Start Frequency	2.48350 GHz	2.48350 GHz
Stop Frequency	2.50000 GHz	2.50000 GHz
Span	16.500 MHz	16.500 MHz
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	330	~ 330
SweepTime	18.945 μ s	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace

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Stablevalue	0.50 dB	0.50 dB
Run	4 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.00 dB	0.50 dB

7.7 Band Edge Compliance (BEC), radiated

Applicability

This requirement applies to all types of DTS equipment.

Description

Emissions within a restricted band and within 2 MHz of an authorized band edge may be measured using either the marker-delta method (ANSI C63.10, 6.10.6) or the integration method (ANSI C63.20, 11.13.3), provided that the DTS bandwidth (or EBW) edge falls within 2 MHz of the band edge. Otherwise, all unwanted emissions measurements shall be performed using the standard methods.

Limits

§15.247

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator 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, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, 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) (see §15.205(c)).

Test procedure

The marker-delta method as described in ANSI C63.10, 6.10.6 or the integration method as described in ANSI C63.10, 11.13.3 can be used to perform measurements of the unwanted emissions level at the band edges.

Test setup: 8.2 with radiated test sample (see section 5.2)

Test results

BEC	low channel AVG / Peak [dμV/m @3m]	high channel AVG / Peak [dμV/m @3m]	Limit AVG / Peak [dμV/m @3m]
Mode 1	≤ 40 AVG / ≤ 55 PK	≤ 40 AVG / ≤ 55 PK	≤ 54 AVG / ≤ 74 PK

Comment:

Verdict

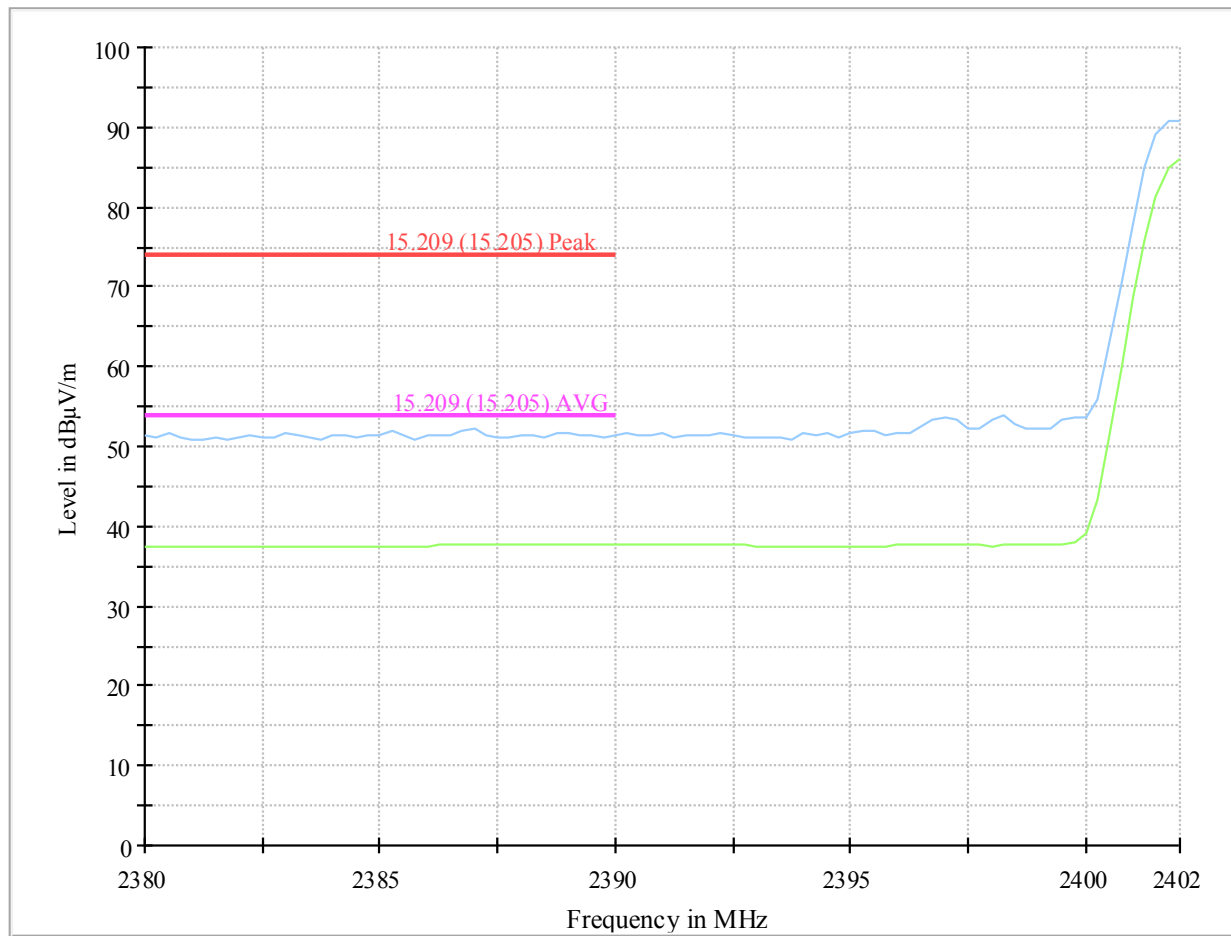
- PASS -

see next plots*

* description of traces for radiated Bend Edge Compliance (BEC) measurements:

 positive Peak (Max Hold) trace
 average Peak (Max Hold) trace

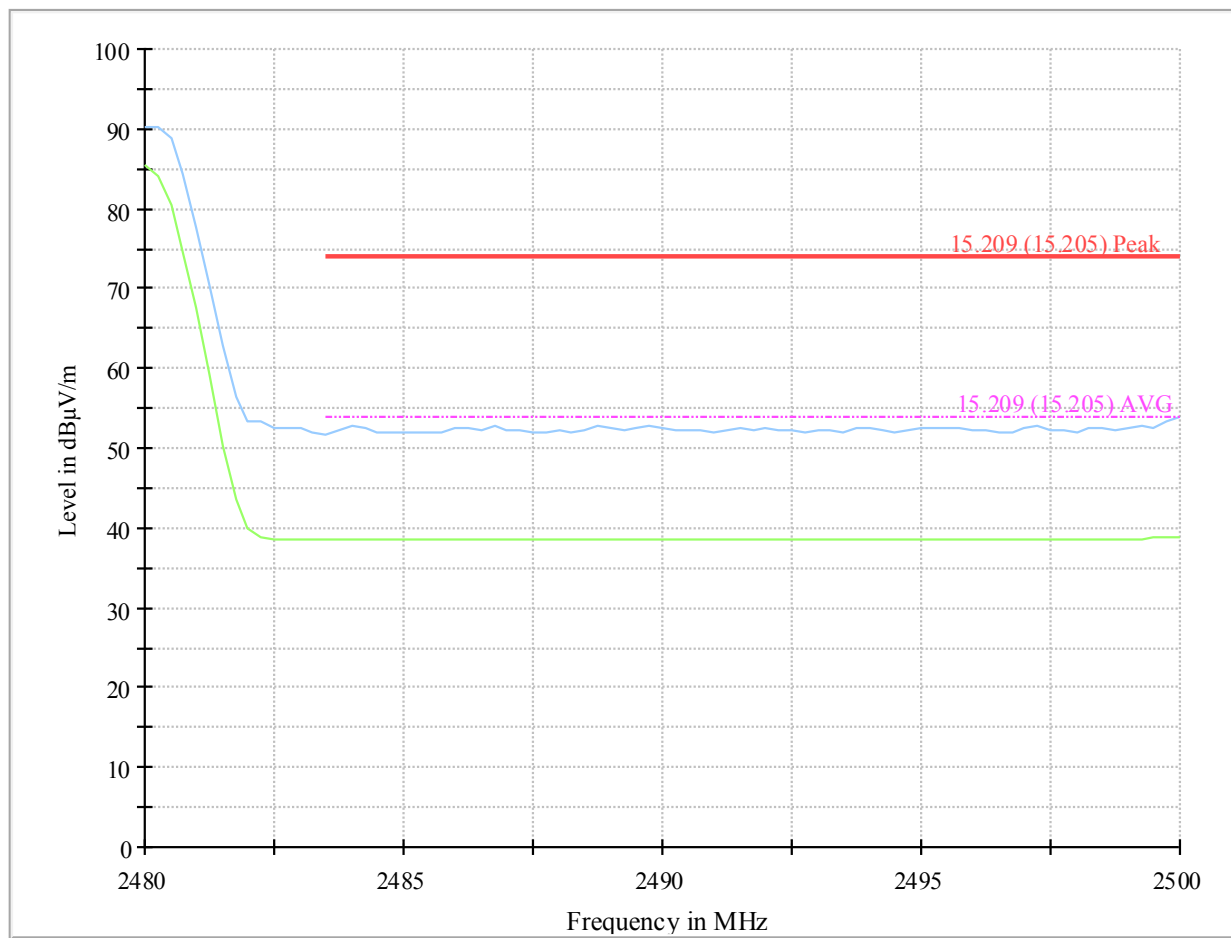
Plot 18: Mode 1, BEC, low channel



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2021-09-03

Plot 19: Mode 1, BEC, high channel



7.8 Conducted Spurious Emissions (CSE)

Applicability

This requirement applies to all types of DTS equipment.

Description

Spurious emission / unwanted emissions are emission on a frequency or frequencies which are outside the authorized band and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products.

Limits

§15.247

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator 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, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. Attenuation below the general limits specified in §15.209(a) is not required.

Test procedure

ANSI C63.10, 11.11

Reference level measurement:

Establish a reference level by using the following procedure:

- Set instrument center frequency to DTS channel center frequency.
 - Set the span to ≥ 1.5 times the DTS bandwidth.
 - Set the RBW = 100 kHz.
 - Set the VBW $\geq [3 \times \text{RBW}]$.
 - Detector = peak.
 - Sweep time = auto couple.
 - Trace mode = max hold.
 - Allow trace to fully stabilize.
 - Use the peak marker function to determine the maximum PSD level.
- Note that the channel found to contain the maximum PSD level can be used to establish the reference level.

Emission level measurement:

Establish an emission level by using the following procedure:

- Set the center frequency and span to encompass frequency range to be measured.
- Set the RBW = 100 kHz.
- Set the VBW $\geq [3 \times \text{RBW}]$.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level.

Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) is attenuated by at least the minimum requirements as specified (≥ 20 dBc).

The marker-delta method, as described in ANSI C63.10, 6.10.6 can be used to perform measurements of the radiated unwanted emissions level at the band-edges provided that the 99 % OBW of the fundamental emission is within 2 MHz of the authorized band edge.

Test setup: 8.4 with conducted test sample (see section 5.2)

Test results

EUT Mode / Channel	Frequency [MHz]	Peak/RMS Detector	Level [dBm]	Limit [dBm]	Verdict
Mode 1	see plots	MaxPeak	see plots	see plots	- passed -

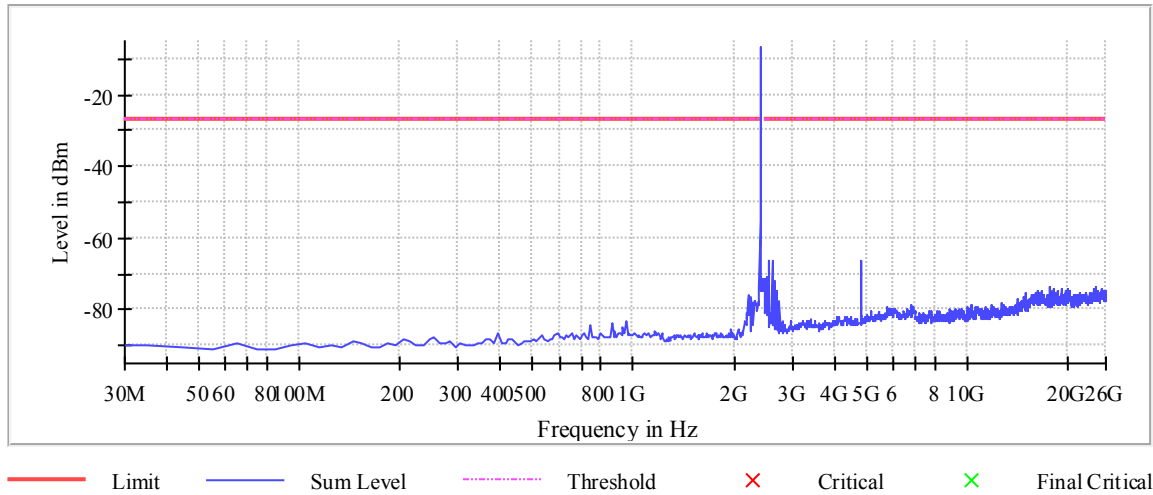
* all detected peaks are more than 6 dB below the limit

Comment:	---
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Verdict	- PASS -	see next plots
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Plot 20: Mode 1, CSE, low channel

Spurious



Result

DUT Frequency (MHz)	Result
2402.000000	PASS

Final measurements

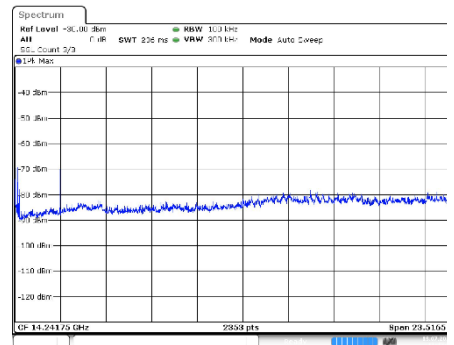
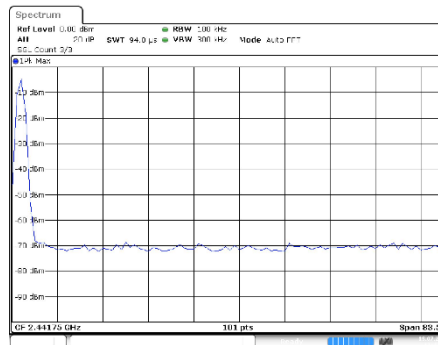
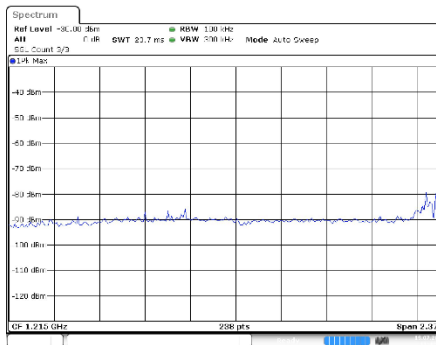
Frequency (MHz)	Level Pre Measurement (dBm)	level (dBm)	Limit (dBm)	Margin (dB)	Result
---	---	---	---	---	---

Pre Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
2395.021008	-55.0	28.1	-27.0
2598.434020	-66.1	39.1	-27.0
4807.166065	-66.4	39.4	-27.0
2548.462707	-66.6	39.6	-27.0
2498.491394	-70.6	43.7	-27.0
2638.411071	-71.9	44.9	-27.0
17719.753400	-73.4	46.4	-27.0
24256.001169	-73.7	46.8	-27.0
2385.063025	-73.8	46.8	-27.0
23796.265087	-73.9	47.0	-27.0
18089.541118	-74.0	47.1	-27.0
25345.375797	-74.1	47.2	-27.0
25465.306949	-74.4	47.4	-27.0
19888.508394	-74.4	47.5	-27.0
19148.932958	-74.4	47.5	-27.0

Measurement Settings

Start Frequency (MHz)	Stop Frequency (MHz)	Pre Measurement	Final Measurement
30.000000	2400.000000	1	1
2400.000000	2483.500000	1	1
2483.500000	26000.000000	1	1

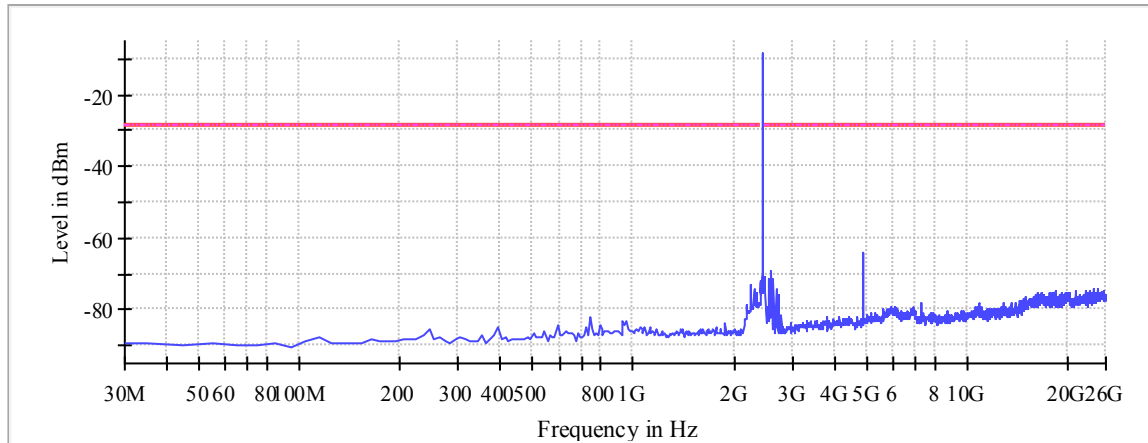


Pre Measurement 1

Setting	Instrument Value	Target Value
RBW	100.000 kHz	≤ 100.000 kHz
VBW	300.000 kHz	≥ 300.000 kHz
SweepPoints	238	~ 238
SweepTime	23.700 ms	AUTO
Reference Level	-30.000 dBm	-30.000 dBm
Attenuation	0.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	3	3
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	Sweep	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	4 / max. 40	max. 40
Stable	3 / 3	3
Max Stable Difference	0.00 dB	0.50 dB

Plot 21: Mode 1, CSE, mid channel

Spurious



— Limit — Sum Level — Threshold × Critical × Final Critical

Result

DUT Frequency (MHz)	Result
2440.000000	PASS

Final measurements

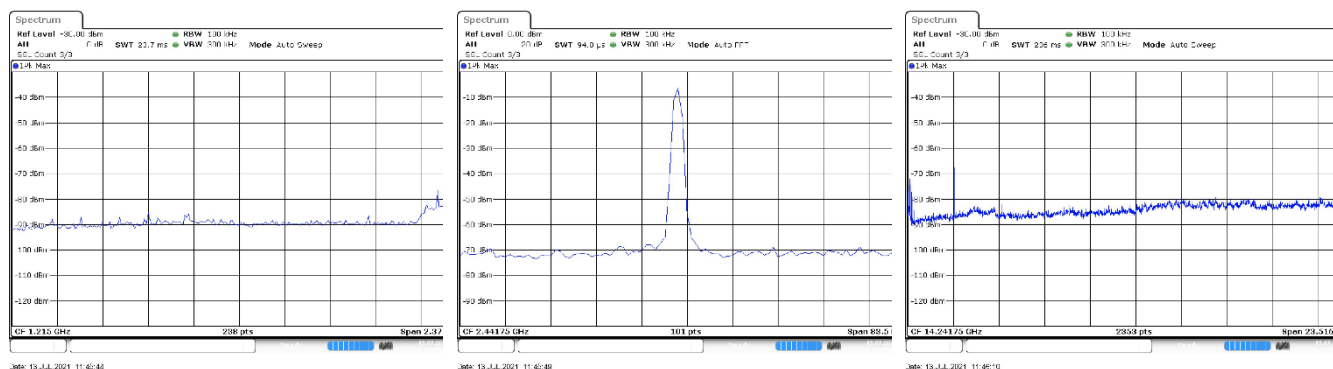
Frequency (MHz)	Level Pre Measurement (dBm)	level (dBm)	Limit (dBm)	Margin (dB)	Result
---	---	---	---	---	---

Pre Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
4877.125903	-64.2	35.6	-28.6
2588.439758	-68.9	40.3	-28.6
2538.468445	-71.2	42.6	-28.6
2628.416808	-71.4	42.8	-28.6
2245.651261	-73.2	44.7	-28.6
23776.276562	-74.0	45.5	-28.6
2488.497131	-74.0	45.5	-28.6
2678.388122	-74.2	45.6	-28.6
2295.441176	-74.3	45.8	-28.6
24655.771674	-74.4	45.8	-28.6
23796.265087	-74.5	45.9	-28.6
25305.398746	-74.6	46.0	-28.6
23216.597854	-74.6	46.1	-28.6
18379.374734	-74.7	46.2	-28.6
25745.146303	-74.8	46.2	-28.6

Measurement Settings

Start Frequency (MHz)	Stop Frequency (MHz)	Pre Measurement	Final Measurement
30.000000	2400.000000	1	1
2400.000000	2483.500000	1	1
2483.500000	26000.000000	1	1

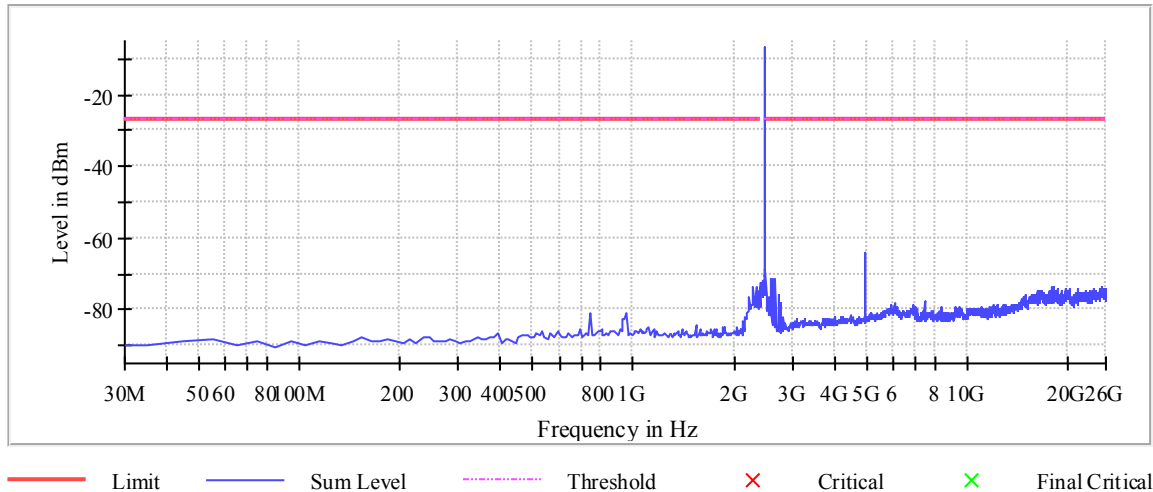


Pre Measurement 1

Setting	Instrument Value	Target Value
RBW	100.000 kHz	≤ 100.000 kHz
VBW	300.000 kHz	≥ 300.000 kHz
SweepPoints	238	~ 238
SweepTime	23.700 ms	AUTO
Reference Level	-30.000 dBm	-30.000 dBm
Attenuation	0.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	3	3
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	Sweep	AUTO
Preamplifier	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	18 / max. 40	max. 40
Stable	3 / 3	3
Max Stable Difference	0.00 dB	0.50 dB

Plot 22: Mode 1, CSE, high channel

Spurious



Result

DUT Frequency (MHz)	Result
2480.000000	PASS

Final measurements

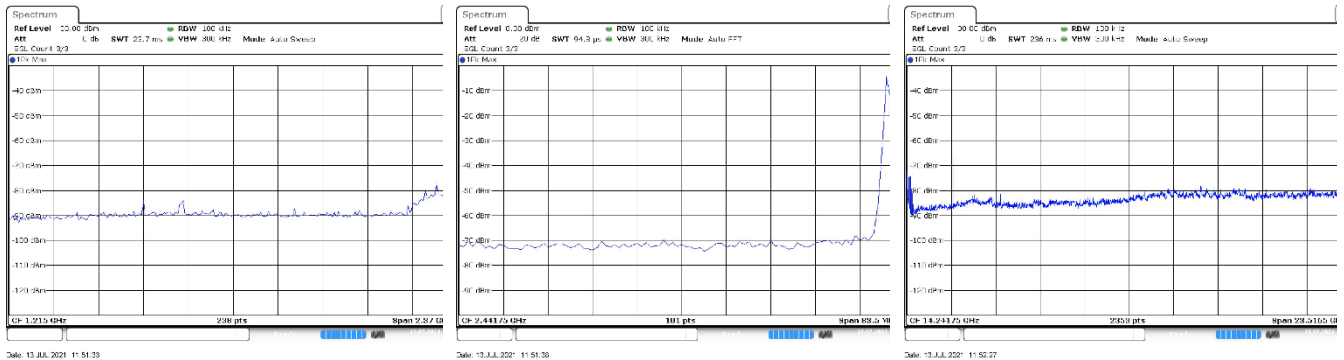
Frequency (MHz)	Level Pre Measurement (dBm)	level (dBm)	Limit (dBm)	Margin (dB)	Result
---	---	---	---	---	---

Pre Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
4957.080004	-63.9	37.2	-26.7
2488.497131	-68.8	42.1	-26.7
2668.393859	-71.1	44.5	-26.7
2628.416808	-71.2	44.5	-26.7
2578.445495	-71.5	44.8	-26.7
2335.273109	-73.4	46.7	-26.7
18019.581279	-73.5	46.8	-26.7
2285.483193	-73.5	46.8	-26.7
25345.375797	-73.7	47.0	-26.7
18049.564067	-73.7	47.1	-26.7
25545.261050	-73.9	47.3	-26.7
23846.236400	-74.0	47.3	-26.7
21477.596154	-74.1	47.4	-26.7
18739.168190	-74.2	47.5	-26.7
23796.265087	-74.3	47.6	-26.7

Measurement Settings

Start Frequency (MHz)	Stop Frequency (MHz)	Pre Measurement	Final Measurement
30.000000	2400.000000	1	1
2400.000000	2483.500000	1	1
2483.500000	26000.000000	1	1



Pre Measurement 1

Setting	Instrument Value	Target Value
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	238	~ 238
Sweeptime	23.700 ms	AUTO
Reference Level	-30.000 dBm	-30.000 dBm
Attenuation	0.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	3	3
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	Sweep	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	14 / max. 40	max. 40
Stable	3 / 3	3
Max Stable Difference	0.00 dB	0.50 dB

7.9 Radiated Spurious Emissions (RSE)

Applicability

This requirement applies to all types of DTS equipment.

Description

Spurious emission / unwanted emissions are emission on a frequency or frequencies which are outside the authorized band and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products. Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation.

Limits

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator 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, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, 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) (see §15.205(c)).

Frequency [MHz]	Field Strength [$\mu\text{V/m}$] / [dB $\mu\text{V/m}$]	Measurement distance [m]
0.009 – 0.490	2400/F[kHz]	300
0.490 – 1.705	24000/F[kHz]	30
1.705 – 30.0	30.0 / 29.5	30
30 – 88	100 / 40.0	3
88 – 216	150 / 43.5	3
216 – 960	200 / 46.0	3
960 – 40 000	500 / 54.0	3

Note

Radiated Spurious Emissions (RSE) are performed for low / mid / high channel.

Test setup: 8.1, 8.2, 8.3 with radiated test sample (see section 5.2)

Test results					
EUT Mode / Channel	Frequency [MHz]	Peak/RMS Detector	Level** [dBm]	Limit [dBm]	Verdict
Mode 1	see plots	MaxPeak	see plots	see plots	- passed -

* all detected peaks are more than 6 dB below the limit

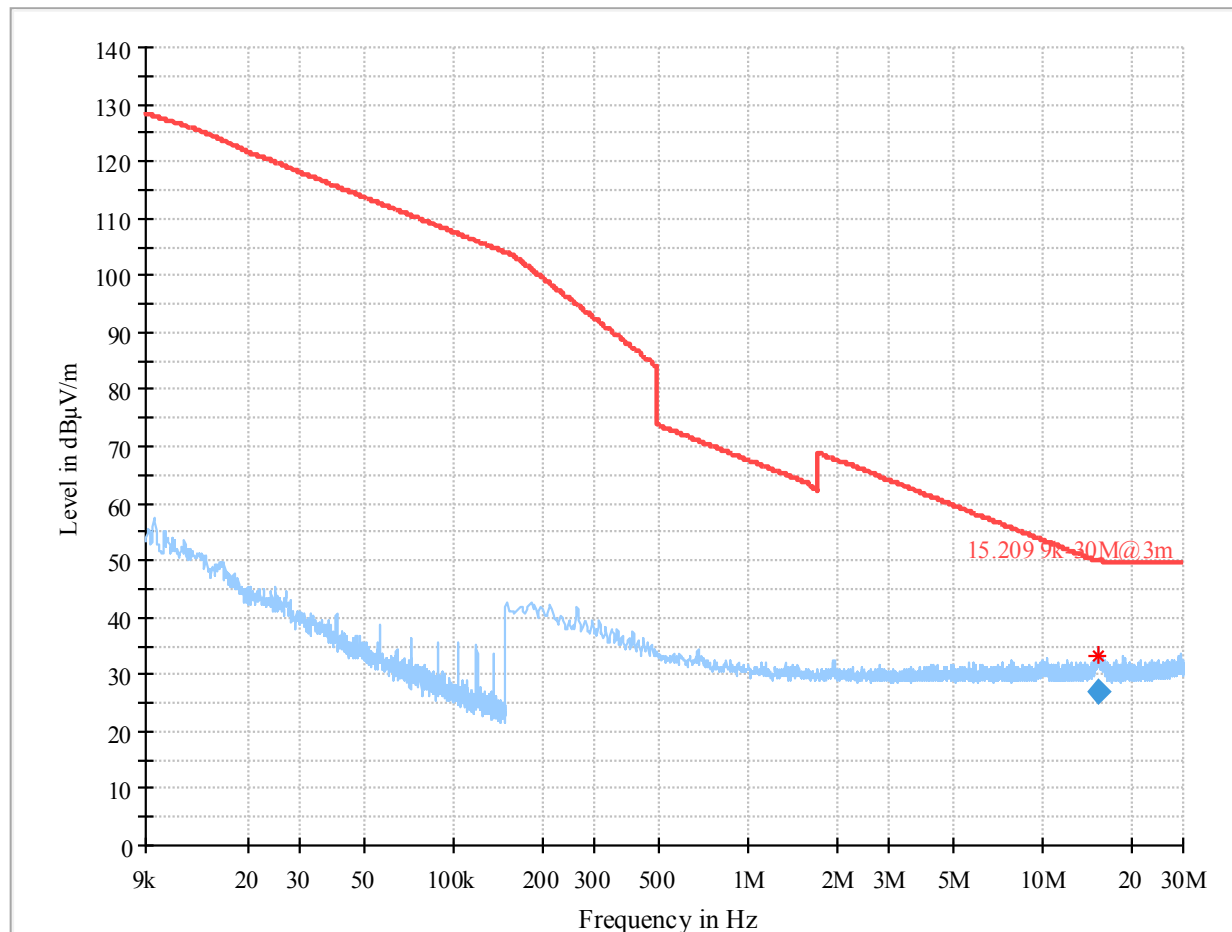
** description of line and marker for all radiated spurious emission (RSE) measurements:

-  positive Peak (Max Hold) trace during pre-scan
-  Max Peak value
-  final Quasi Peak value

Comment:	---
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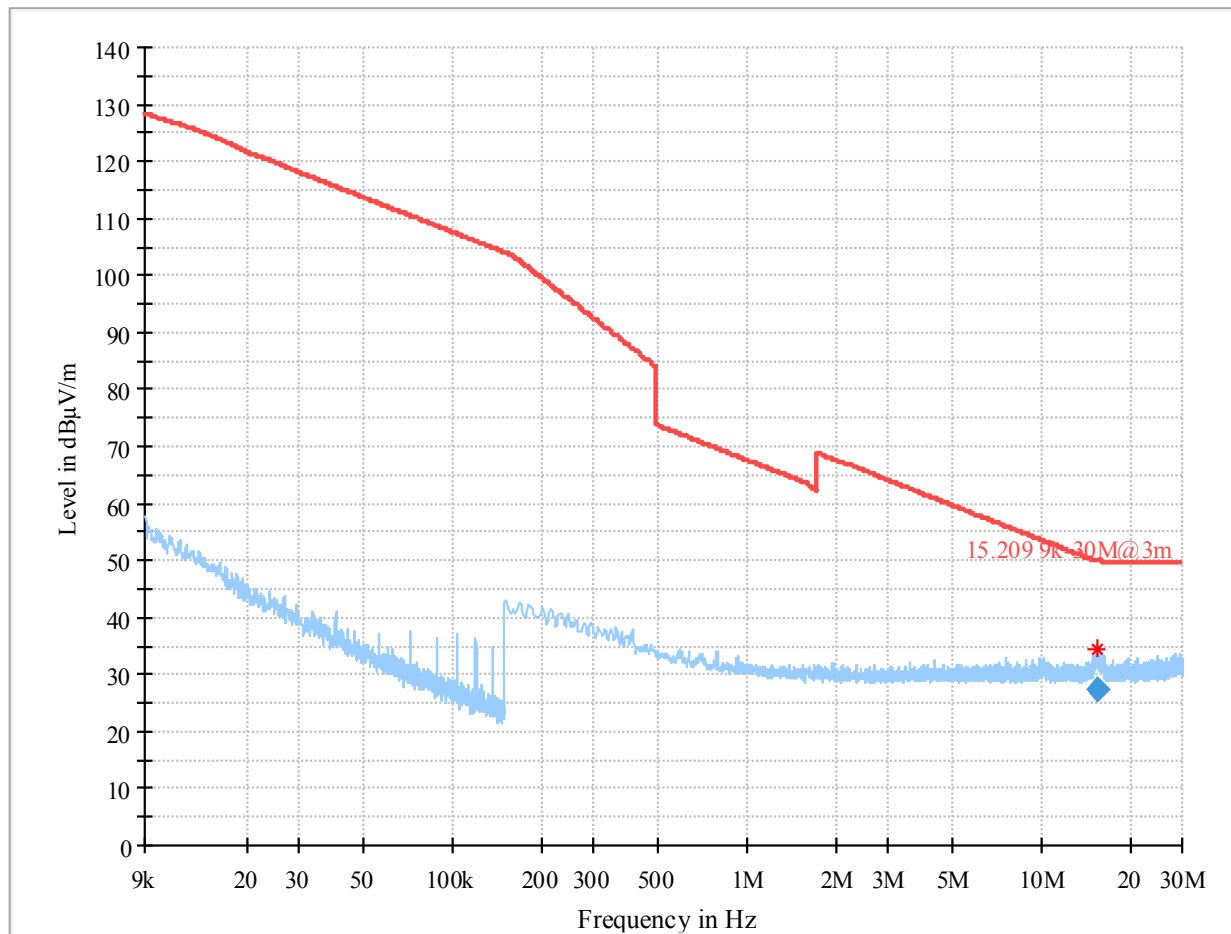
Verdict	- PASS -	see next plots
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Plot 23: Mode 1, RSE 9 kHz – 30 MHz, low channel, loop antenna

**Final Result**

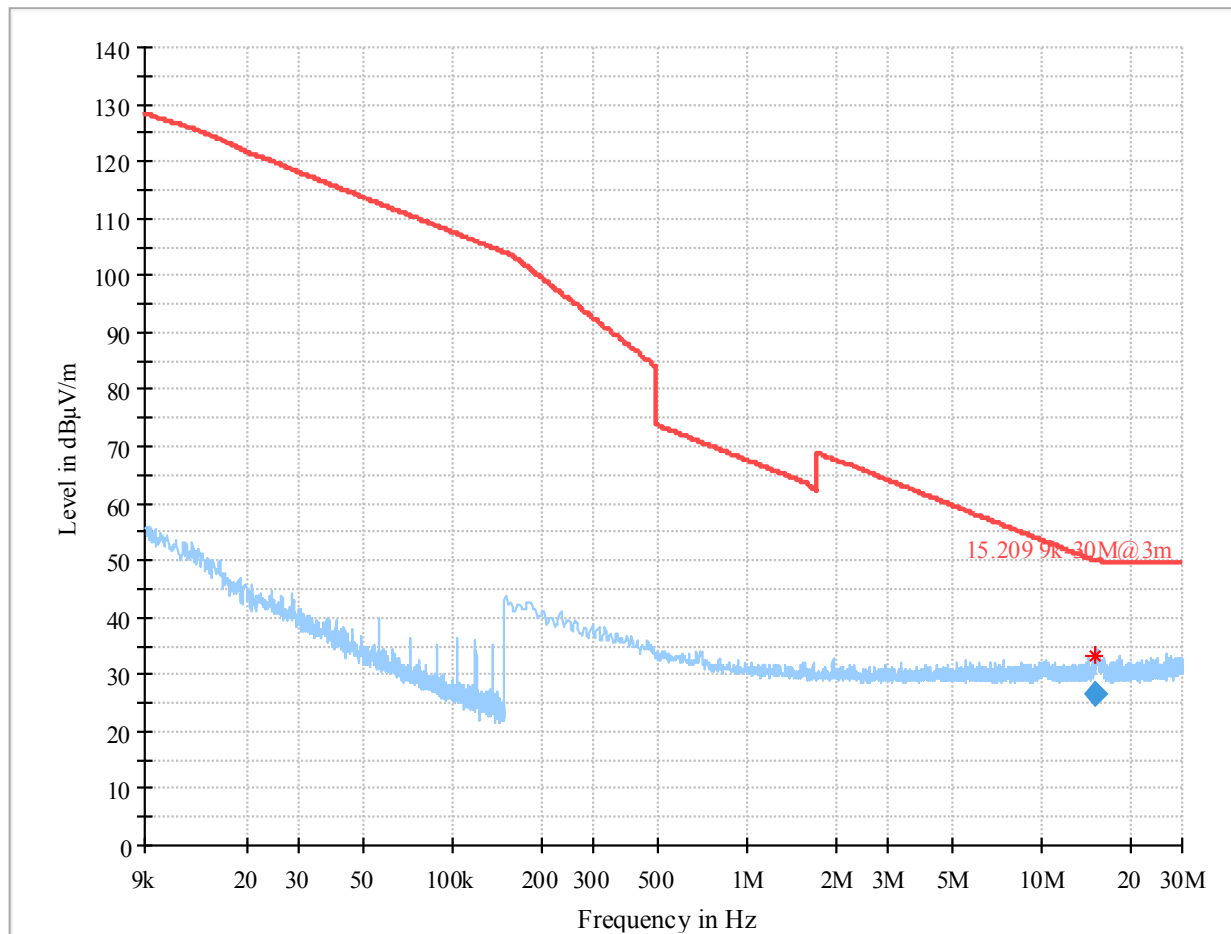
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
15.382500	27.02	50.04	23.02	100.0	9.000	H	240.0	20.5

Plot 24: Mode 1, RSE 9 kHz – 30 MHz, mid channel, loop antenna

**Final Result**

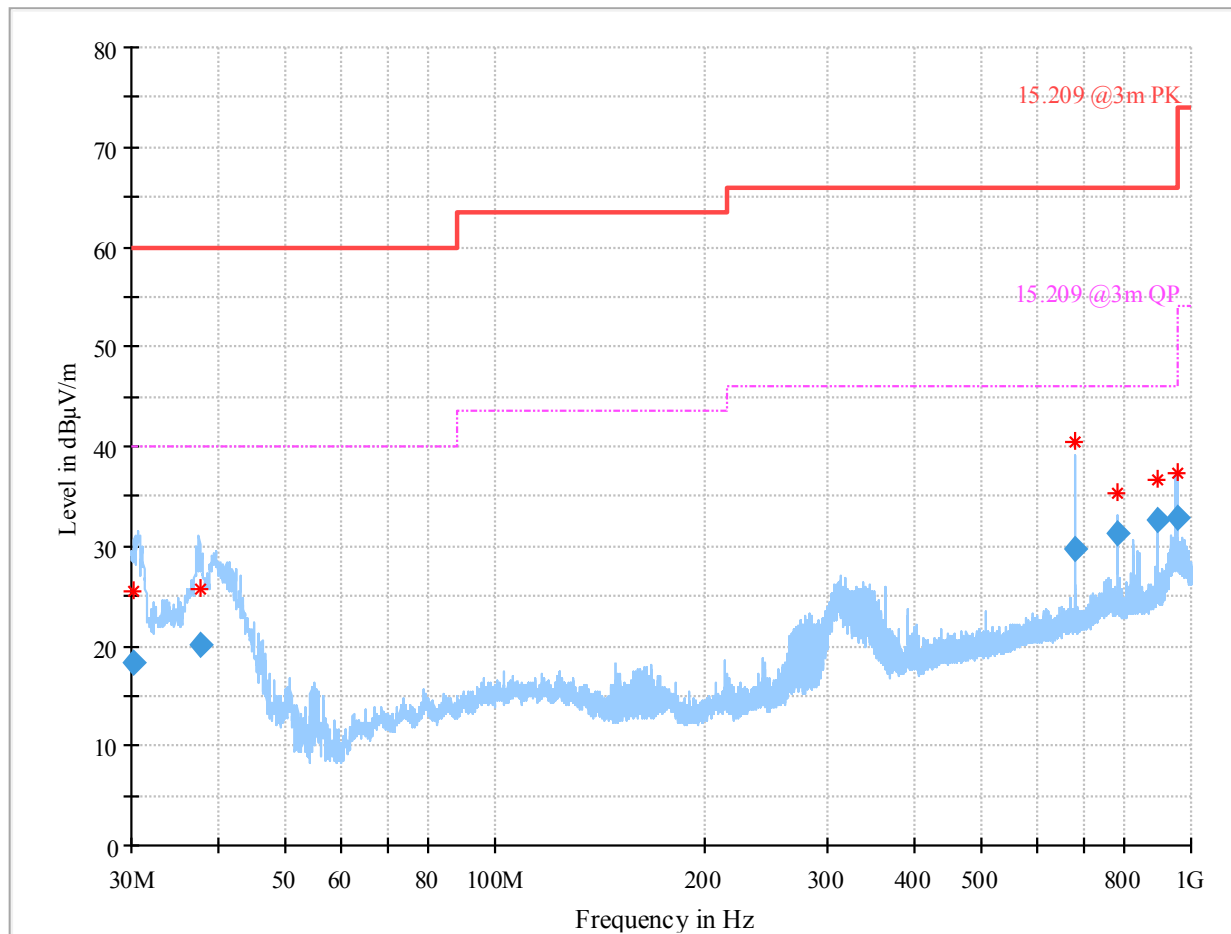
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
15.382500	27.21	50.04	22.83	100.0	9.000	H	240.0	20.5

Plot 25: Mode 1, RSE 9 kHz – 30 MHz, high channel, loop antenna

**Final Result**

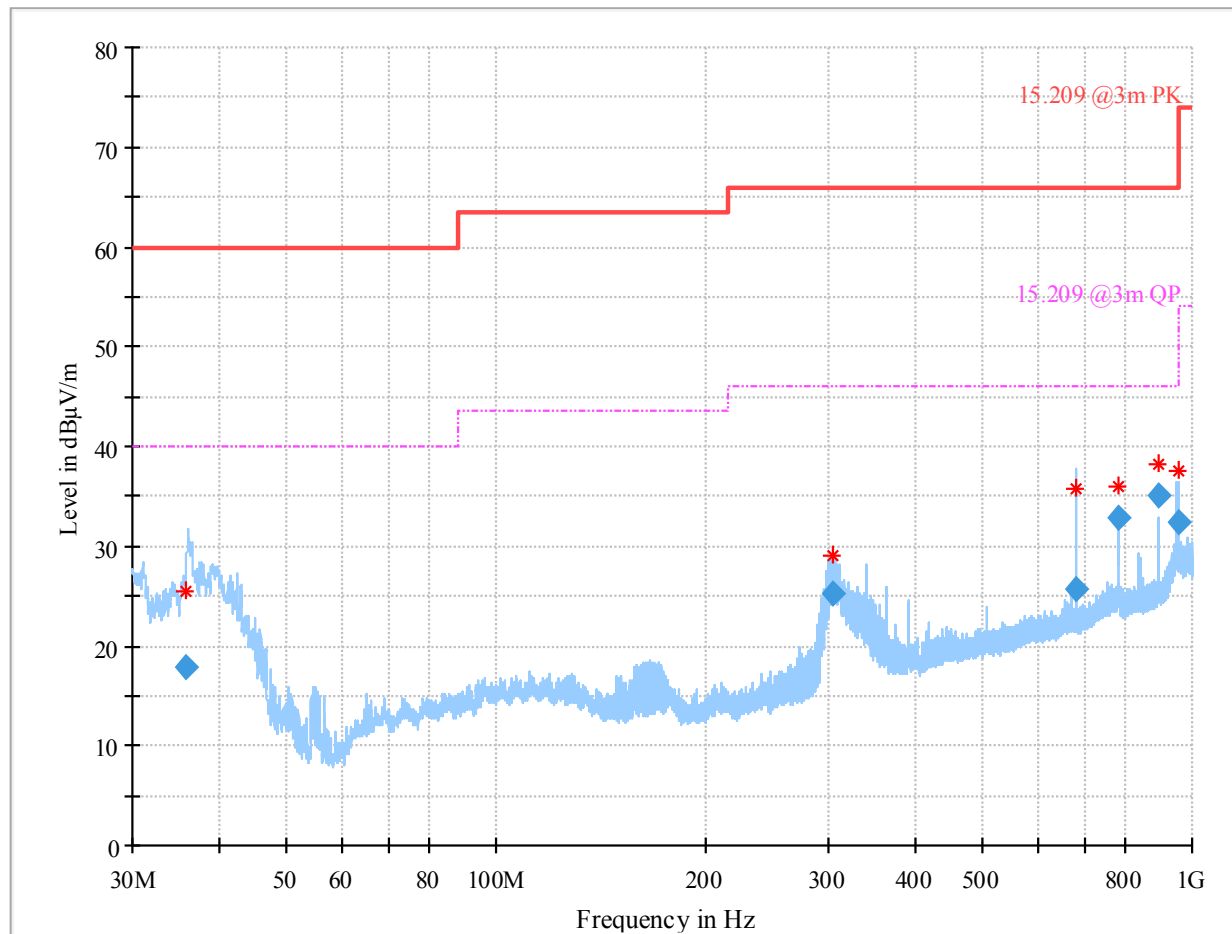
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
15.272250	26.40	50.04	23.64	100.0	9.000	H	240.0	20.5

Plot 26: Mode 1, RSE 30 MHz – 1 GHz, low channel, horizontal / vertical polarisation

**Final Result**

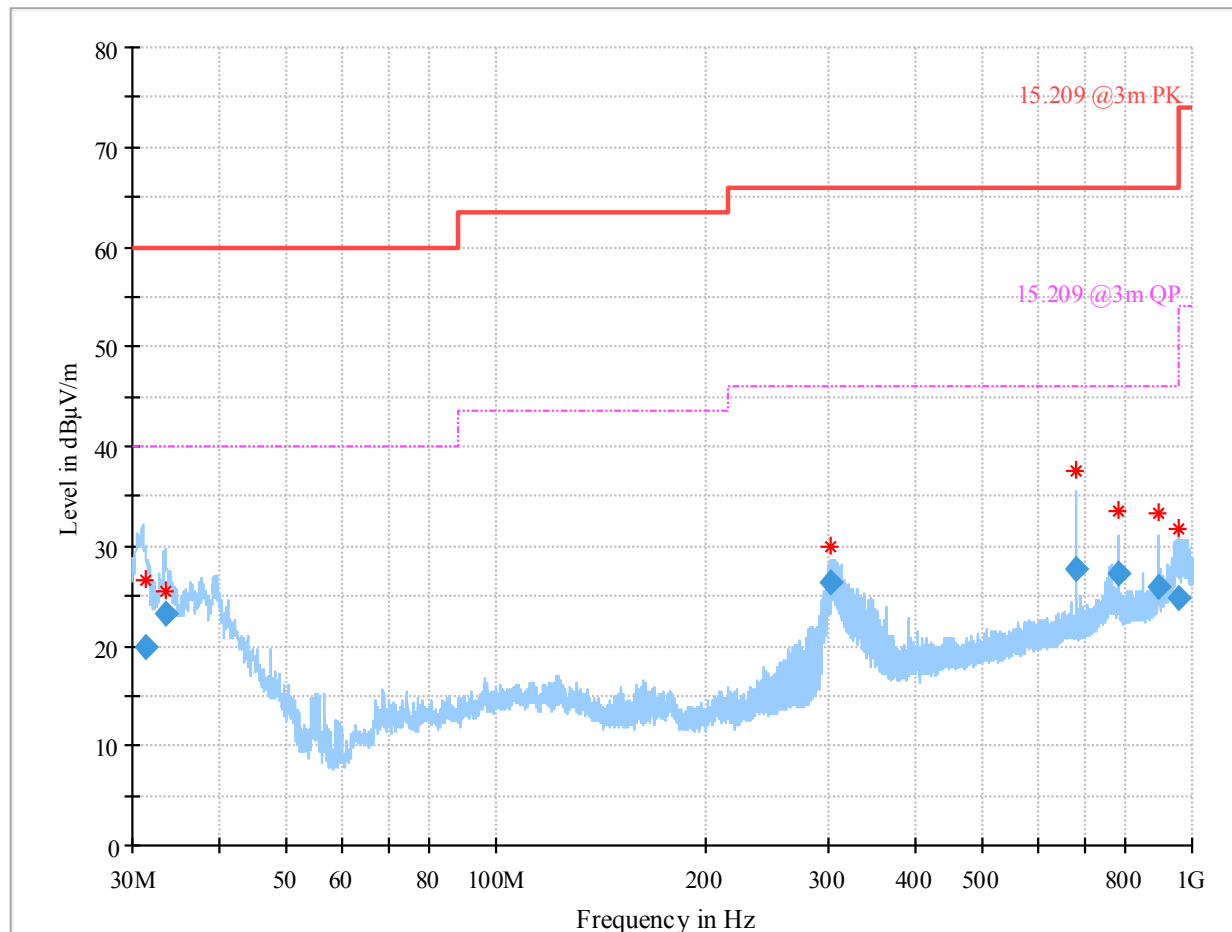
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
30.200000	18.32	60.00	41.68	100.0	120.000	100.0	V	256.0
37.825000	20.10	60.00	39.90	100.0	120.000	104.0	V	283.0
681.600000	29.64	66.00	36.36	100.0	120.000	126.0	V	195.0
782.275000	31.26	66.00	34.74	100.0	120.000	185.0	V	-16.0
893.975000	32.72	66.00	33.28	100.0	120.000	176.0	H	322.0
953.525000	32.77	66.00	33.23	100.0	120.000	183.0	V	187.0

Plot 27: Mode 1, RSE 30 MHz – 1 GHz, mid channel, horizontal / vertical polarisation

**Final Result**

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
35.850000	17.83	60.00	42.17	100.0	120.000	117.0	V	300.0
305.350000	25.36	66.00	40.64	100.0	120.000	125.0	V	-5.0
681.600000	25.67	66.00	40.33	100.0	120.000	149.0	V	76.0
785.225000	32.81	66.00	33.19	100.0	120.000	160.0	V	-16.0
894.000000	35.10	66.00	30.90	100.0	120.000	165.0	H	314.0
953.525000	32.44	66.00	33.56	100.0	120.000	178.0	V	180.0

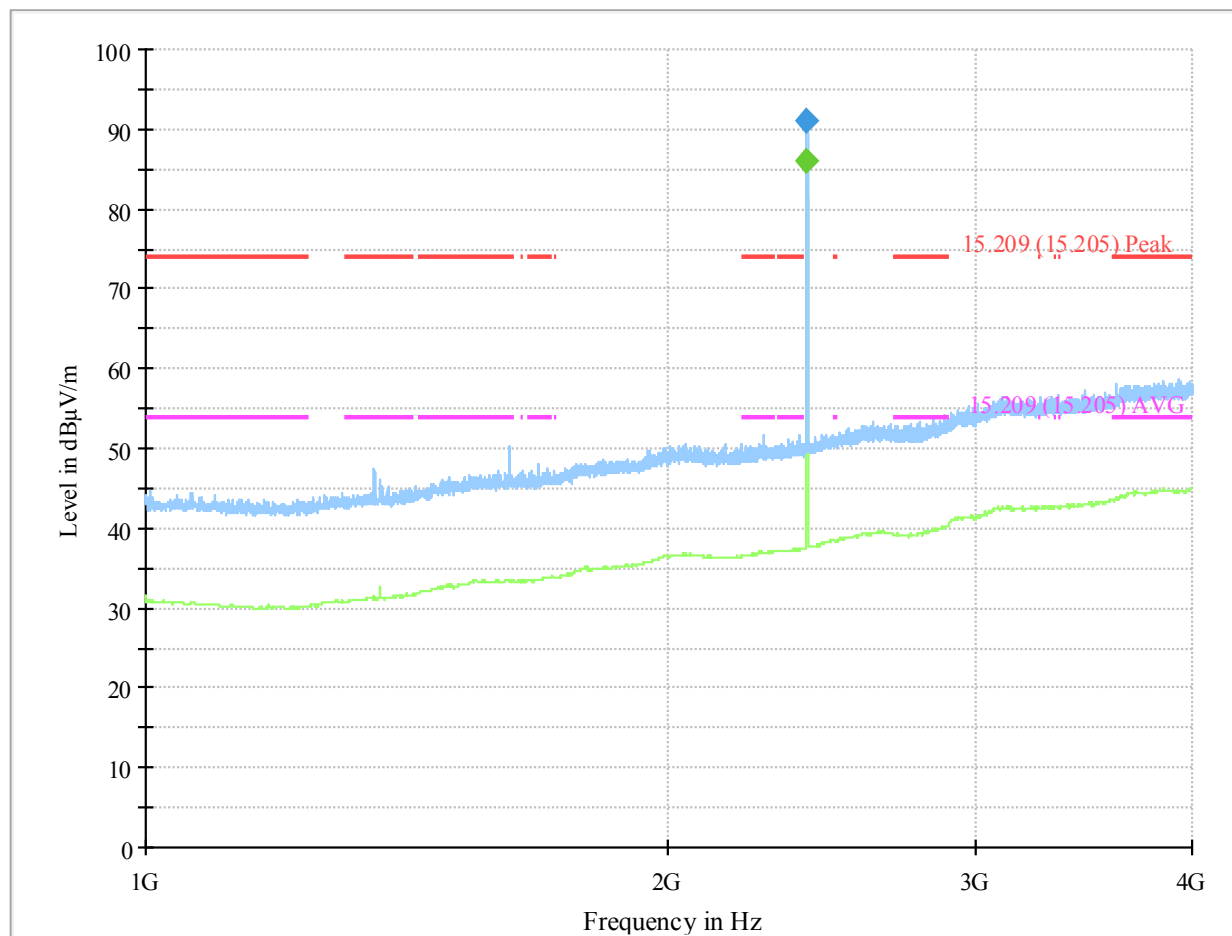
Plot 28: Mode 1, RSE 30 MHz – 1 GHz, high channel, horizontal / vertical polarisation



Final Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
31.450000	19.97	60.00	40.03	100.0	120.000	100.0	V	239.0
33.600000	23.17	60.00	36.83	100.0	120.000	104.0	V	303.0
302.925000	26.38	66.00	39.62	100.0	120.000	103.0	V	-19.0
681.600000	27.76	66.00	38.24	100.0	120.000	103.0	V	60.0
782.300000	27.21	66.00	38.79	100.0	120.000	165.0	V	339.0
897.425000	25.85	66.00	40.15	100.0	120.000	103.0	V	179.0
953.475000	24.90	66.00	41.10	100.0	120.000	138.0	V	188.0

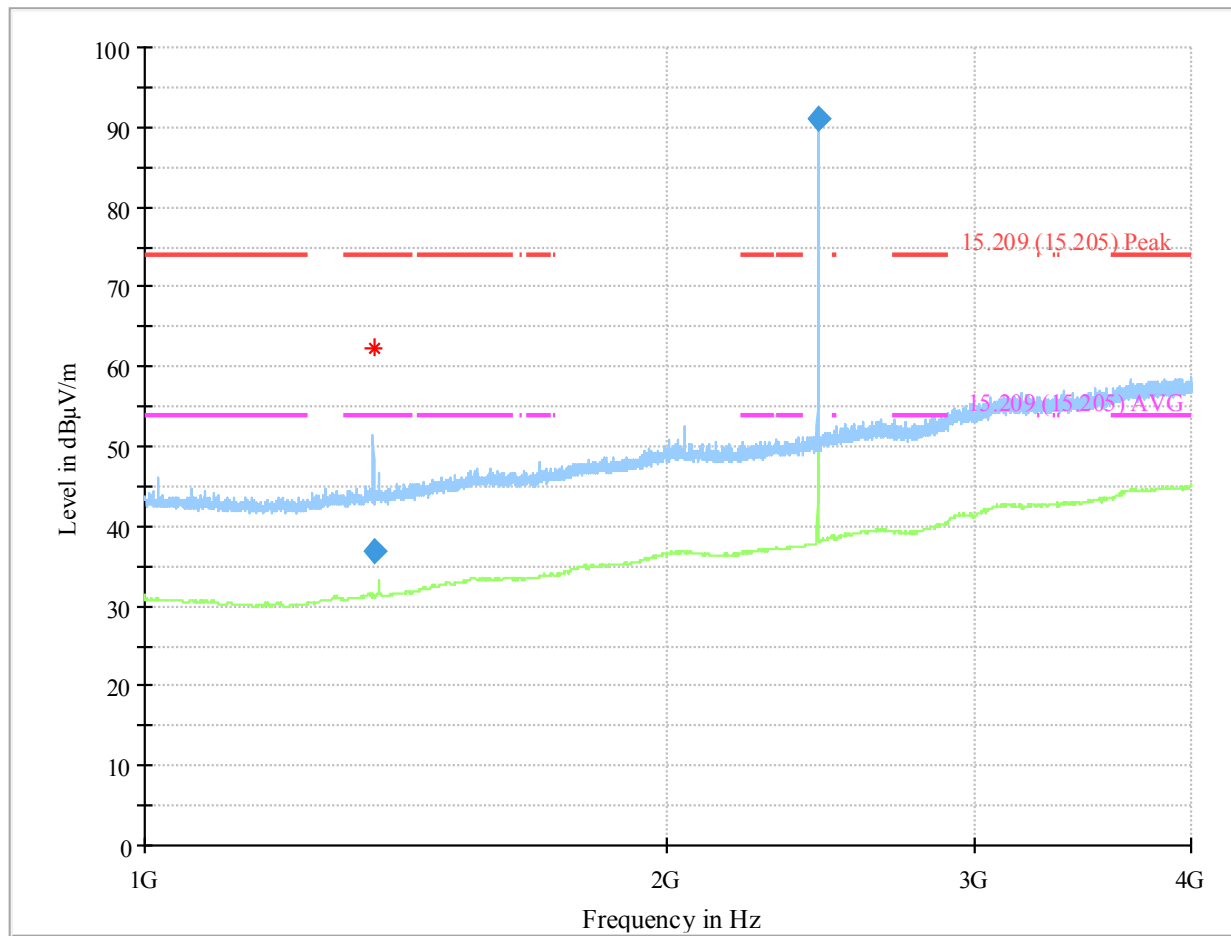
Plot 29: Mode 1, RSE 1 GHz – 4 GHz, low channel, horizontal / vertical polarisation



Final Result

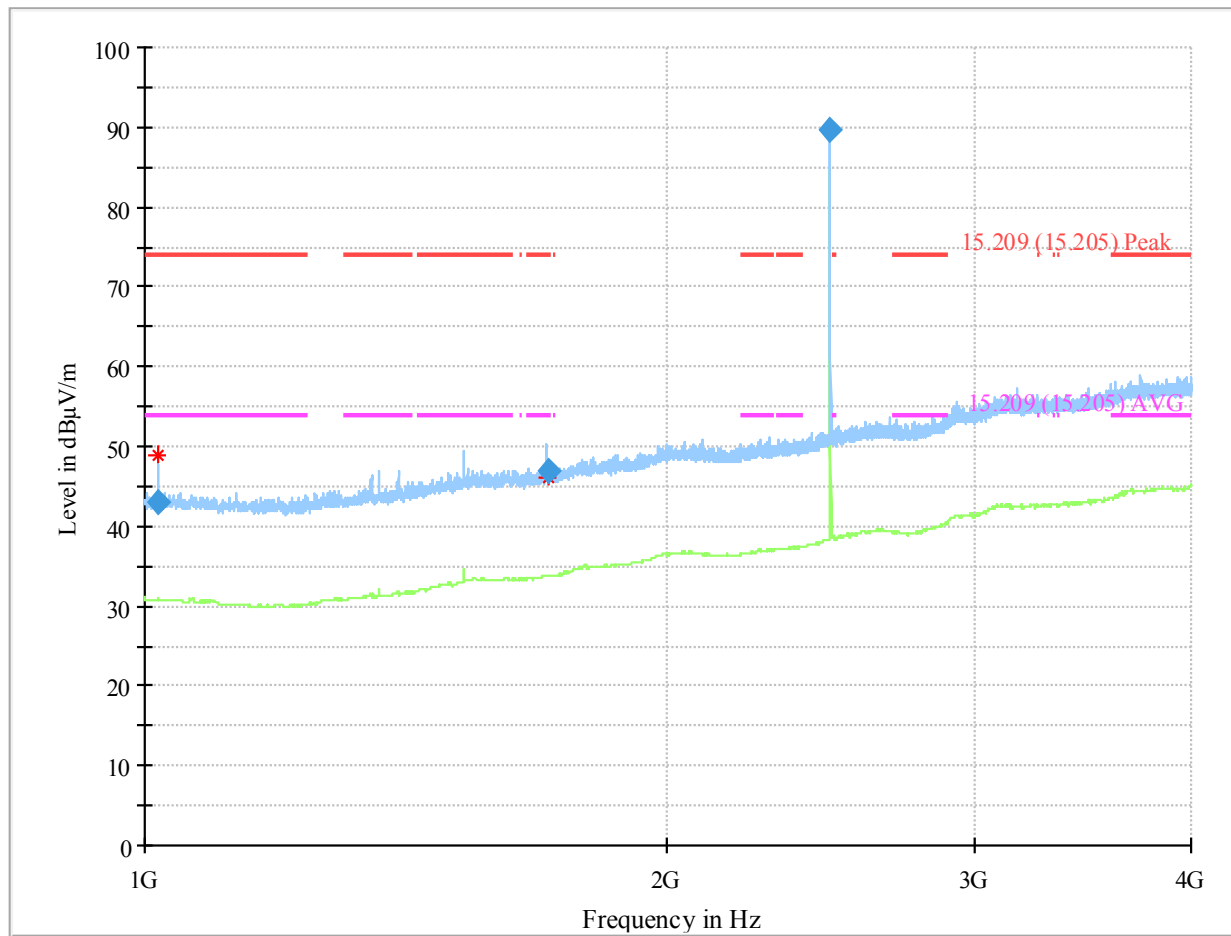
Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
2402.000000	---	86.16	---	---	100.0	1000.000	150.0	H
2402.000000	90.99	---	---	---	100.0	1000.000	150.0	H

Plot 30: Mode 1, RSE 1 GHz – 4 GHz, mid channel, horizontal / vertical polarisation

**Final Result**

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
1355.100000	36.90	---	54.00	17.10	100.0	1000.000	150.0	V
2440.000000	91.10	---	---	---	100.0	1000.000	150.0	H

Plot 31: Mode 1, RSE 1 GHz – 4 GHz, high channel, horizontal / vertical polarisation

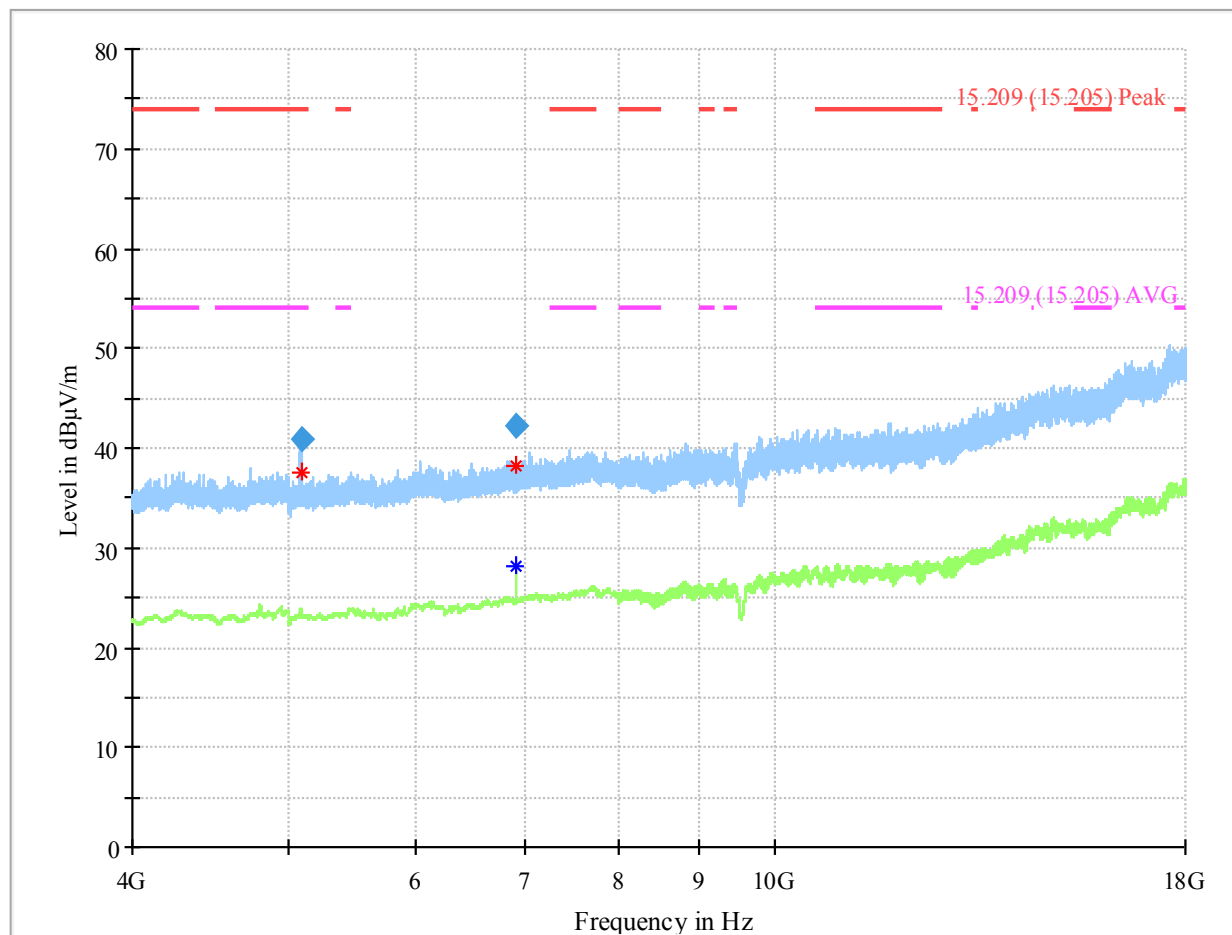
**Final Result**

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
1017.500000	43.10	---	74.00	30.90	100.0	1000.000	150.0	V
1706.750000	46.99	---	74.00	27.01	100.0	1000.000	150.0	H
2480.000000	89.60	---	---	---	100.0	1000.000	150.0	V

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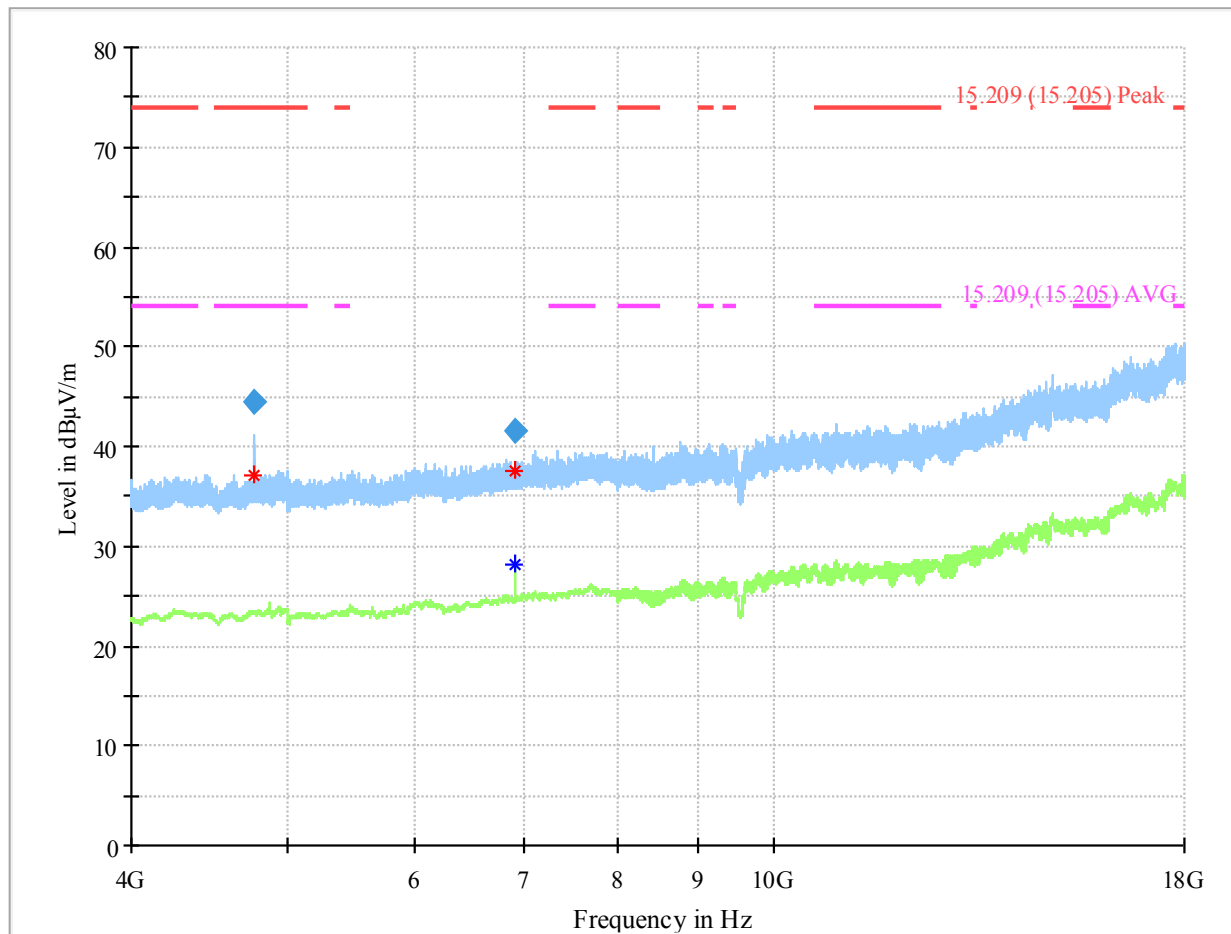
Plot 32: Mode 1, RSE 4 GHz – 18 GHz, low channel, horizontal / vertical polarisation



Final Result

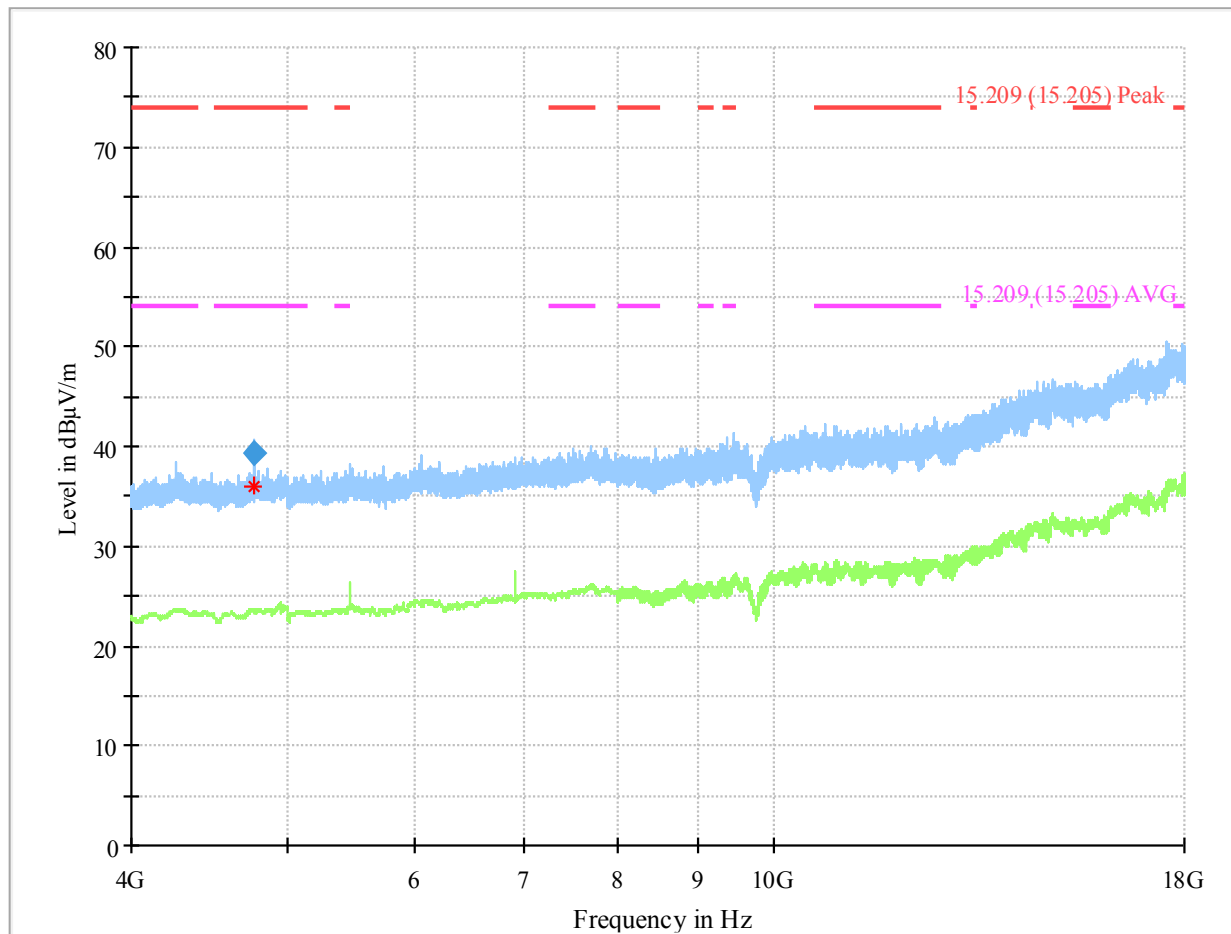
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
5088.400000	40.90	74.00	33.10	100.0	1000.000	150.0	V	219.0
6911.875000	42.17	---	---	100.0	1000.000	150.0	V	224.0

Plot 33: Mode 1, RSE 4 GHz – 18 GHz, mid channel, horizontal / vertical polarisation

**Final Result**

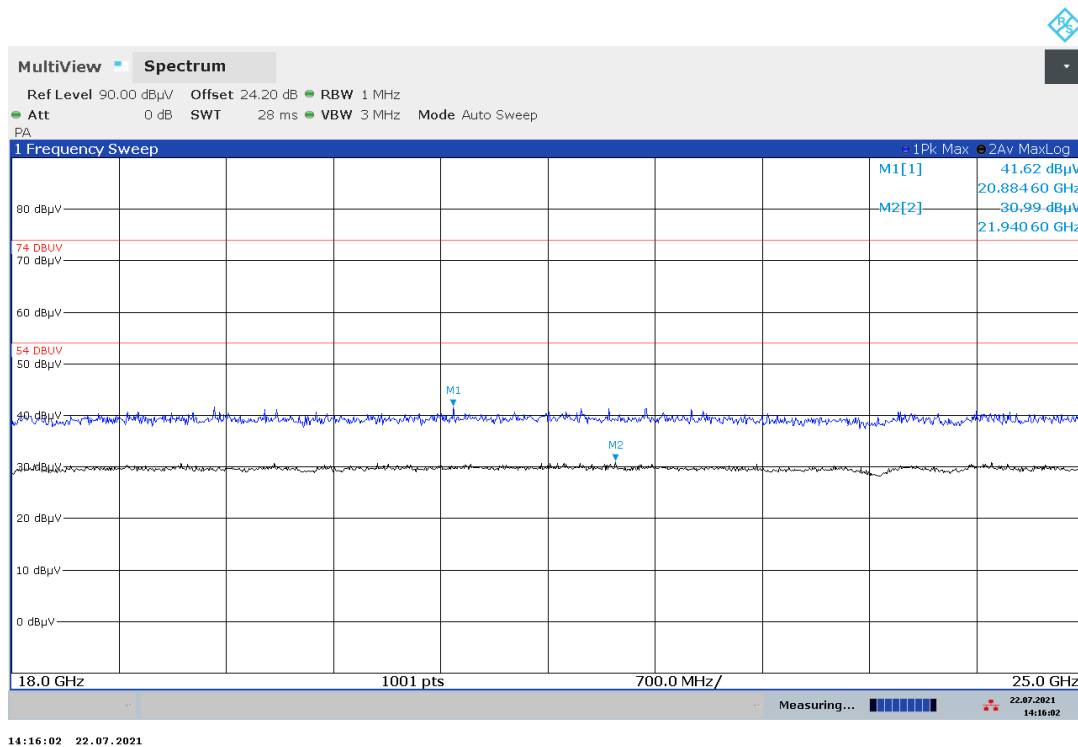
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
4770.925000	44.47	74.00	29.53	100.0	1000.000	150.0	V	45.0
6911.875000	41.54	---	---	100.0	1000.000	150.0	V	231.0

Plot 34: Mode 1, RSE 4 GHz – 18 GHz, high channel, horizontal / vertical polarisation

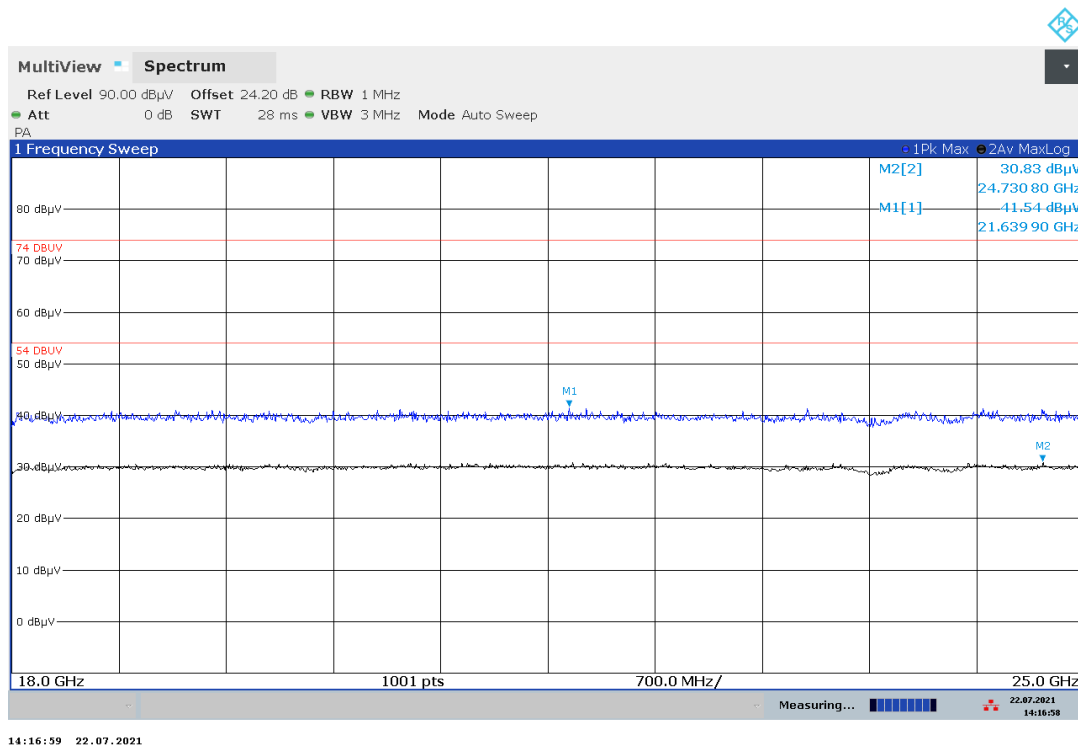
**Final Result**

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
4772.800000	39.33	74.00	34.67	100.0	1000.000	150.0	V	24.0

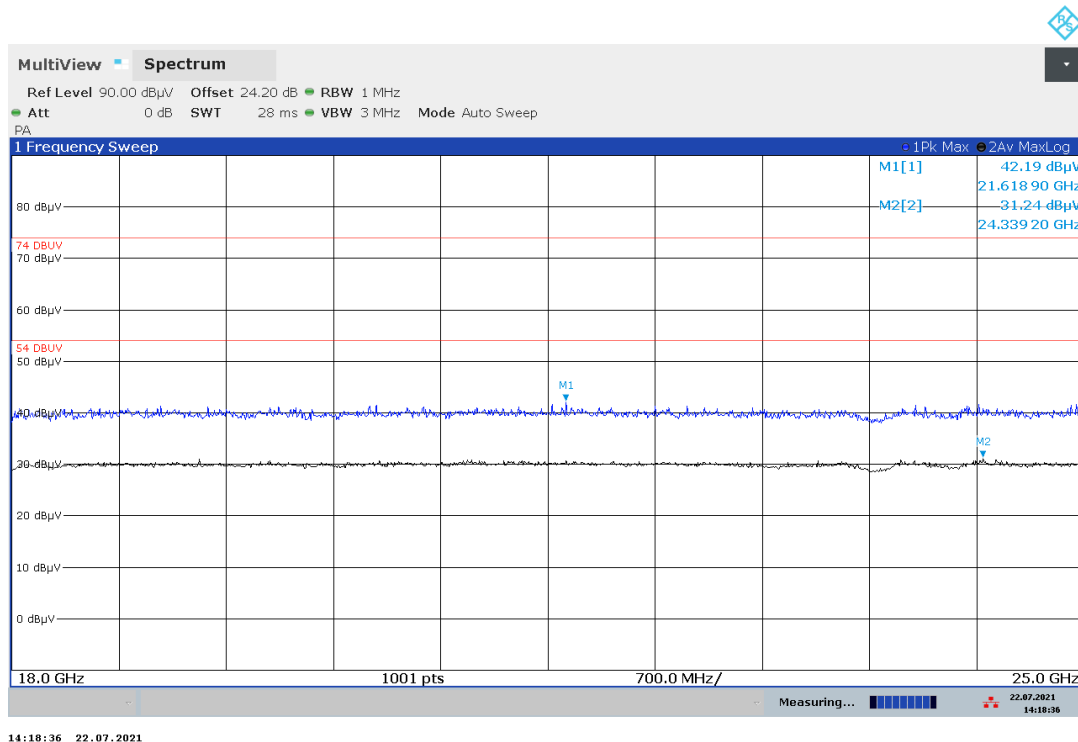
Plot 35: Mode 1, RSE 18 GHz – 25 GHz, low channel, horizontal / vertical polarisation



Plot 36: Mode 1, RSE 18 GHz – 25 GHz, mid channel, horizontal / vertical polarisation



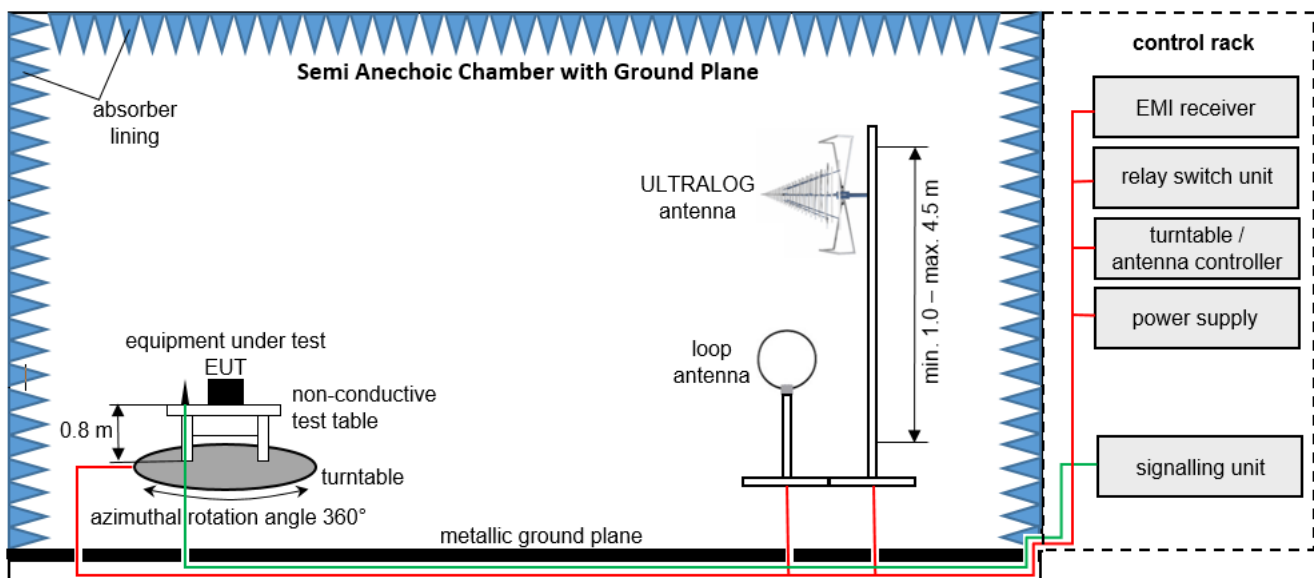
Plot 37: Mode 1, RSE 18 GHz – 25 GHz, high channel, horizontal / vertical polarisation



8 TEST SETUP DESCRIPTION

8.1 Semi Anechoic Chamber with Ground Plane

Radiated measurements are performed in vertical and horizontal plane in the frequency range 30 MHz to 1 GHz in a Semi Anechoic Chamber with a metallic ground plane. The EUT is positioned on a non-conductive test table with a height of 0.80 m above the metallic ground plane that covers the whole chamber. The receiving antennas conform to specification ANSI C63.10-2013, American National Standard for Testing Unlicensed Wireless Devices. These antennas can be moved over the height range between 1.0 m and 4.5 m in order to search for maximum field strength emitted from the EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received. The wanted and unwanted emissions are received by a spectrum analyzer where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.



Measurement distance: loop antenna 3 m, ULTRALOG antenna 3 m
EMC32 software version: 11.10.00

$$FS = UR + CL + AF$$

(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

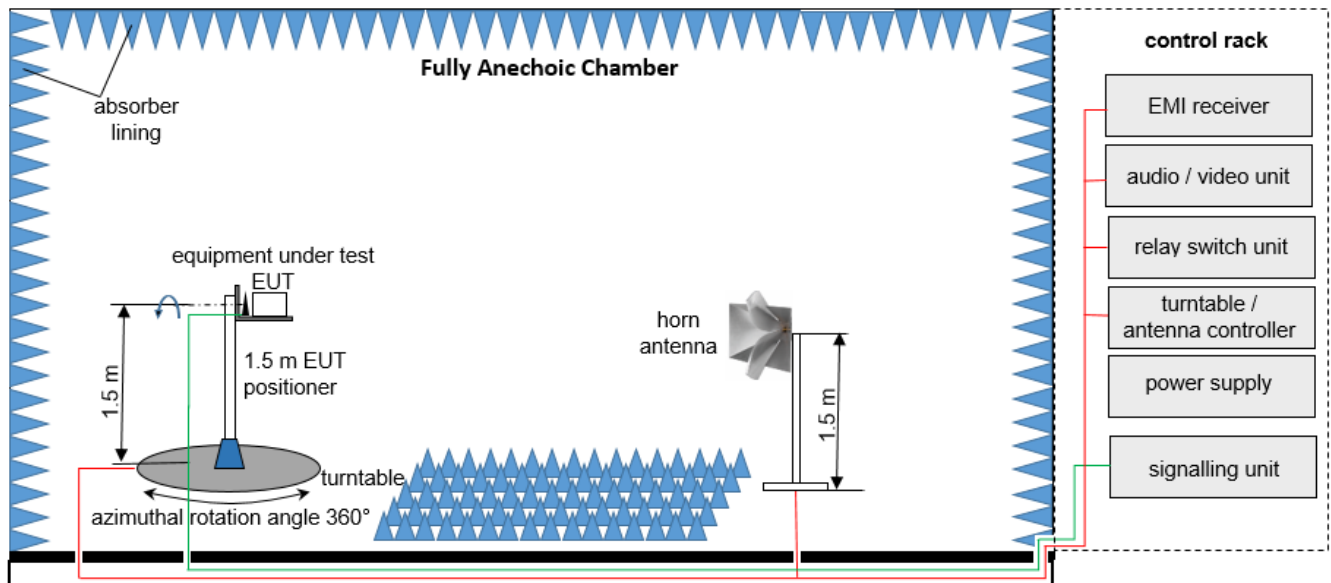
Example calculation:

$$FS \text{ [dB}\mu\text{V/m]} = 12.35 \text{ [dB}\mu\text{V/m]} + 1.90 \text{ [dB]} + 16.80 \text{ [dB/m]} = 31.05 \text{ [dB}\mu\text{V/m]} \text{ (35.69 } \mu\text{V/m)}$$

List of test equipment used:

No.	Equipment	Manufacturer	Type	Serial No.	INV. No.	Last / Next Calibration
1	Power Supply	Elektro-Automatik GmbH & Co. KG	EA-PSI 9080-40 T	2000230001	LAB000313	–
2	Test table	innco systems GmbH	PT1208-080-RH	-	LAB000306	–
3	Power Supply	Chroma	61604	616040005416	LAB000285	–
4	Positioner	matur GmbH	TD 1.5-10KG		LAB000258	–
5	Compressed Air	Implotex	1-850-30	-	LAB000256	–
6	EMI Test Receiver	Rohde & Schwarz	ESW26	101517	LAB000363	2021-02-05 → 2022-02-05
7	Semi-Anechoic Chamber (SAC)	Albatross Projects GmbH	SAC 5 (Babylon 5)	20168.PRB	LAB000235	2020-08-24 → 2021-08-24
8	Measurement Software	Rohde & Schwarz	EMC32 V11.00.10		LAB000226	–
9	Turntable	matur GmbH	TT2.0-2t	TT2.0-2t/921	LAB000225	–
10	Antenna Mast	matur GmbH	CAM4.0-P	CAM4.0-P/316	LAB000224	–
11	Antenna Mast	matur GmbH	BAM4.5-P	BAM4.5-P/272	LAB000223	–
12	Controller	matur GmbH	FCU 3.0	10082	LAB000222	–
13	Power Supply	Elektro-Automatik GmbH & Co. KG	PS 2042-10 B	2878350292	LAB000191	–
14	Pre-Amplifier	Schwarzbeck Mess-Elektronik OHG	BBV 9718 C	84	LAB000169	–
15	Open Switch and Control Platform	Rohde & Schwarz	OSP200 Base Unit 2HU	101748	LAB000149	–
16	Antenna	Rohde & Schwarz	HL562E	102001	LAB000123	2020-07-05 → 2023-07-05
17	Antenna	Rohde & Schwarz	HFH2-Z2E - Active Loop Antenna	100954	LAB000108	2020-03-25 → 2023-03-25

8.2 Fully Anechoic Chamber



Measurement distance: horn antenna 3 meter

EMC32 software version: 11.10.00

$$FS = UR + CL + AF$$

(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

Example calculation:

$$FS [dB\mu V/m] = 12.35 [dB\mu V/m] + 1.90 [dB] + 16.80 [dB/m] = 31.05 [dB\mu V/m] (35.69 \mu V/m)$$

$$OP = AV + D - G + CA$$

(OP-radiated output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain+amplifier gain; CA-loss signal path)

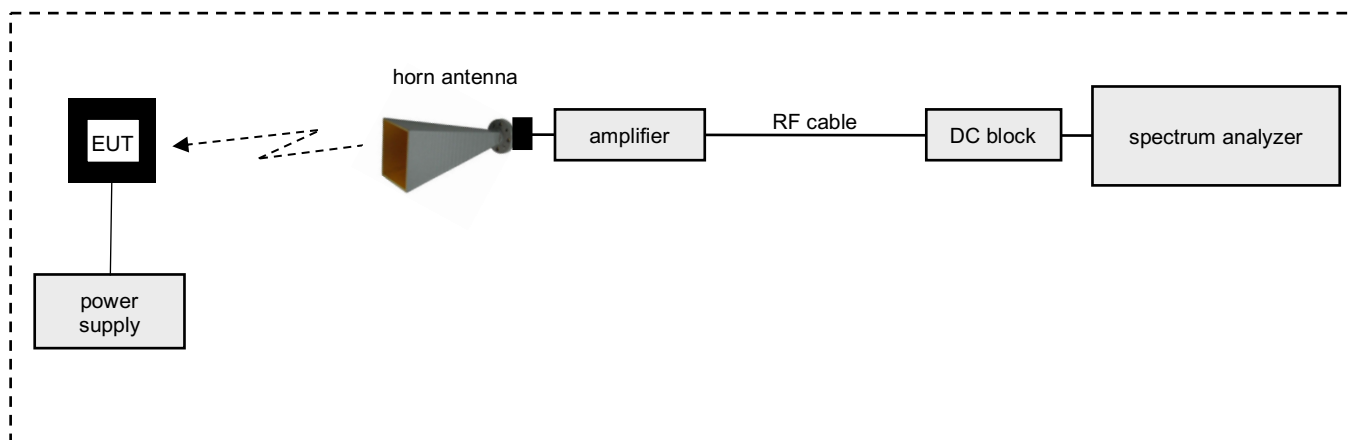
Example calculation:

$$OP [dBm] = -65.0 [dBm] + 50 [dB] - 20 [dBi] + 5 [dB] = -30 [dBm] (1 \mu W)$$

List of test equipment used:

No.	Equipment	Manufacturer	Type	Serial No.	INV. No.	Last / Next Calibration
1	Power Supply	Elektro-Automatik GmbH & Co. KG	EA-PSI 9080-40 T	2000230001	LAB000313	–
2	Test table	innco systems GmbH	PT1208-080-RH	-	LAB000306	–
3	Power Supply	Chroma	61604	616040005416	LAB000285	–
4	Positioner	matur GmbH	TD 1.5-10KG	–	LAB000258	–
5	Compressed Air	Implotex	1-850-30	-	LAB000256	–
6	EMI Test Receiver	Rohde & Schwarz	ESW26	101517	LAB000363	2021-02-05 → 2022-02-05
7	Semi-Anechoic Chamber (SAC)	Albatross Projects GmbH	SAC 5 (Babylon 5)	20168.PRB	LAB000235	2020-08-24 → 2021-08-24
8	Measurement Software	Rohde & Schwarz	EMC32 V11.00.10	–	LAB000226	–
9	Turntable	matur GmbH	TT2.0-2t	TT2.0-2t/921	LAB000225	–
10	Antenna Mast	matur GmbH	BAM4.5-P	BAM4.5-P/272	LAB000223	–
11	Controller	matur GmbH	FCU 3.0	10082	LAB000222	–
12	Power Supply	Elektro-Automatik GmbH & Co. KG	PS 2042-10 B	2878350292	LAB000191	–
13	Pre-Amplifier	Schwarzbeck Mess-Elektronik OHG	BBV 9718 C	84	LAB000169	–
14	Open Switch and Control Platform	Rohde & Schwarz	OSP200 Base Unit 2HU	101748	LAB000149	–
15	Antenna	Rohde & Schwarz	HF907	102898	LAB000124	2020-04-23 → 2023-04-23
16	HP-filter	AtlantRF	–	–	LAB000382	–

8.3 Radiated measurements > 18 GHz

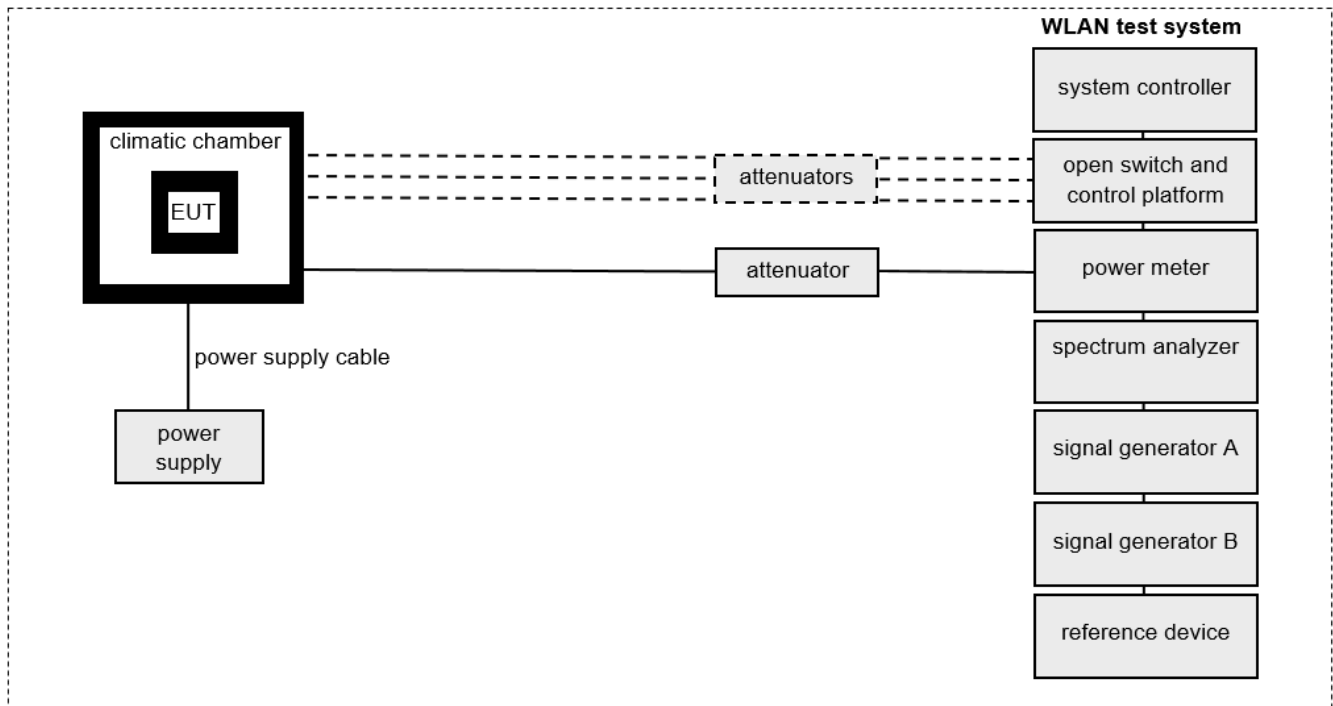


List of test equipment used:

No.	Equipment	Manufacturer	Type	Serial No.	INV. No.	Last / Next Calibration
1	Test table	innco systems GmbH	PT0707-RH light	-	LAB000303	–
2	WG-Coax-Adapter	Flann Microwave Ltd	20093-TF30 UBR220	273374	LAB000181	–
3	Coaxial Cable	Huber & Suhner	SF101/1.5m	503987/1	LAB000165	–
4	Antenna	Flann Microwave Ltd	20240-20	266403	LAB000128	2020-06-29 → 2023-06-29
5	Spectrum Analyser	Rohde & Schwarz	FSW43	101391	LAB000289	2021-07-02 → 2022-07-02

8.4 Conducted measurements WLAN test system R&S TS 8997

The EUT's RF signal is coupled out by the antenna connector which is supplied by the manufacturer. The losses for all signal paths are first checked within a calibration. The measurement readings on the signalling unit/spectrum analyzer are corrected by the specific test set-up loss. The attenuator, power divider, signalling unit and the spectrum analyzer are impedance matched on 50 Ohm.



EMC32/WMS32 software version: 11.00.00

List of test equipment used:

No.	Equipment	Manufacturer	Type	Serial No.	INV. No.	Last / Next Calibration
1	TS8997-Rack	Rohde & Schwarz	TS8997-Rack	100829	LAB000322	–
2	Open Switch and Control Platform	Rohde & Schwarz	OSP-B157WX	101247	LAB000280	–
3	Open Switch and Control Platform	Rohde & Schwarz	OSP-B157W8	100982	LAB000279	–
4	Spectrum Analyser	Rohde & Schwarz	FSV40	101403	LAB000278	2021-06-15 → 2022-06-15
5	Signal Generator	Rohde & Schwarz	SMBV100A	258240	LAB000277	2021-06-02 → 2022-06-02
6	Signal Generator	Rohde & Schwarz	SMB100A-20	178175	LAB000276	2021-05-27 → 2022-05-27
7	Radio Communication Tester	Rohde & Schwarz	CMW270	101479	LAB000275	–
8	Controller	Hewlett Packard	ATS-Z230	101379	LAB000274	–
9	Power Supply	EA	PS 2042-10 B	2878350263	LAB000190	–

9 MEASUREMENT UNCERTAINTIES

Radio frequency	$\leq \pm 1 \times 10^{-7}$
RF power, conducted	$\leq \pm 0.75 \text{ dB}$
Power spectral density	$\leq \pm 3 \text{ dB}$
Maximum frequency deviation	$\leq \pm 5 \%$
Deviation limitation Duty Cycle, Tx-sequence, Tx-gap	$\leq \pm 5 \%$
Occupied channel bandwidth	$\leq \pm 5 \%$
Conducted spurious emission of transmitter	$\leq \pm 4 \text{ dB}$
Conducted emission of receivers	$\leq \pm 4 \text{ dB}$
Radiated emission of transmitter	$\leq \pm 6 \text{ dB}$
Radiated emission of receiver	$\leq \pm 6 \text{ dB}$
Temperature	$\leq \pm 2.5 \text{ °C}$
Humidity	$\leq \pm 10 \%$

The indicated expanded measurement uncertainty corresponds to the standard measurement uncertainty for the measurement results multiplied by the coverage factor $k = 2$. It was determined in accordance with EA-4/02 M:2013. The true value is located in the corresponding interval with a probability of 95 %.