

Occupied Channel Bandwidth 99%

Limits

* RSS-Gen Issue 5, Clause 6.7 Occupied bandwidth (or 99% emission bandwidth) and x dB bandwidth:

The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

Modulation: BT (GFSK 1-DH5)

Results

Operation Band (MHz)	Equipment	Channel Frequency (MHz)	99% Occupied Bandwidth (MHz)
[2400, 2483.5]	Digital Transmission System (DTS)	2402	0.873484433
[2400, 2483.5]	Digital Transmission System (DTS)	2441	0.873155128
[2400, 2483.5]	Digital Transmission System (DTS)	2480	0.876953042

Verdict

Pass

Approved by (name / position & signature)	Antonio José Jurado Industrial & Automotive EMC Lab. Manager
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Attachments

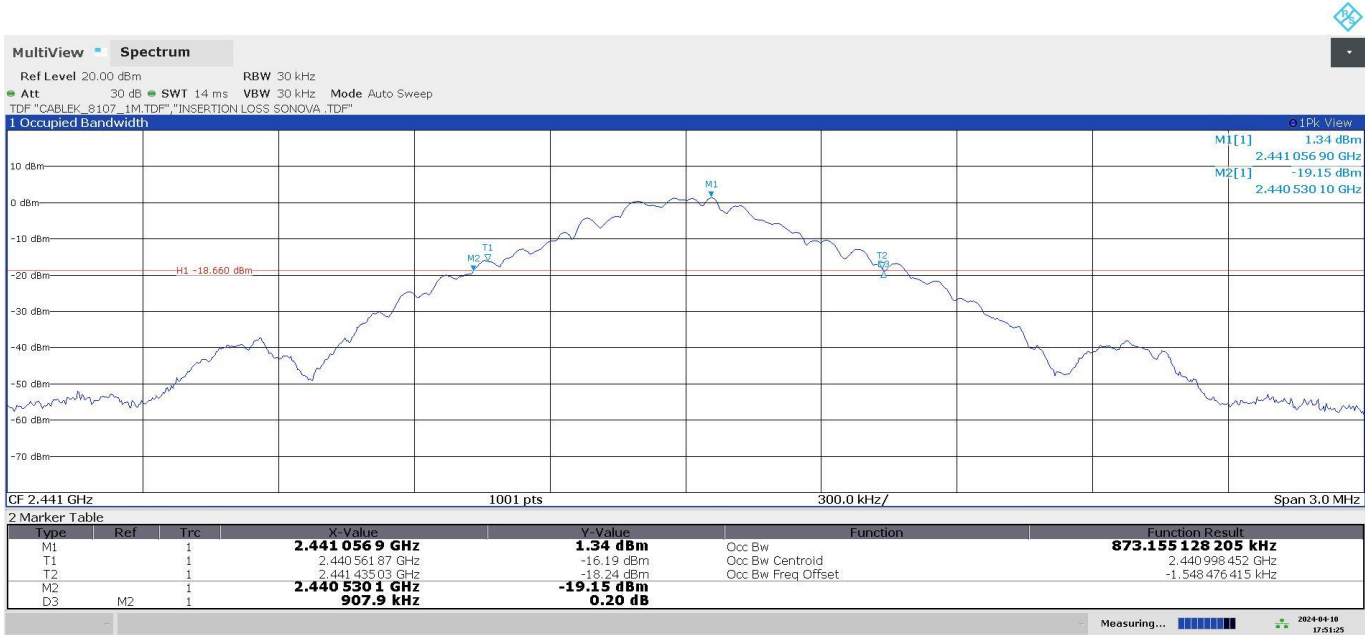
Operation Band MHz = [2400, 2483.5] Modulation = BT (GFSK 1-DH5)
Frequency MHz = 2402.00000

Images:



Operation Band MHz = [2400, 2483.5] Modulation = BT (GFSK 1-DH5)
Frequency MHz = 2441.00000

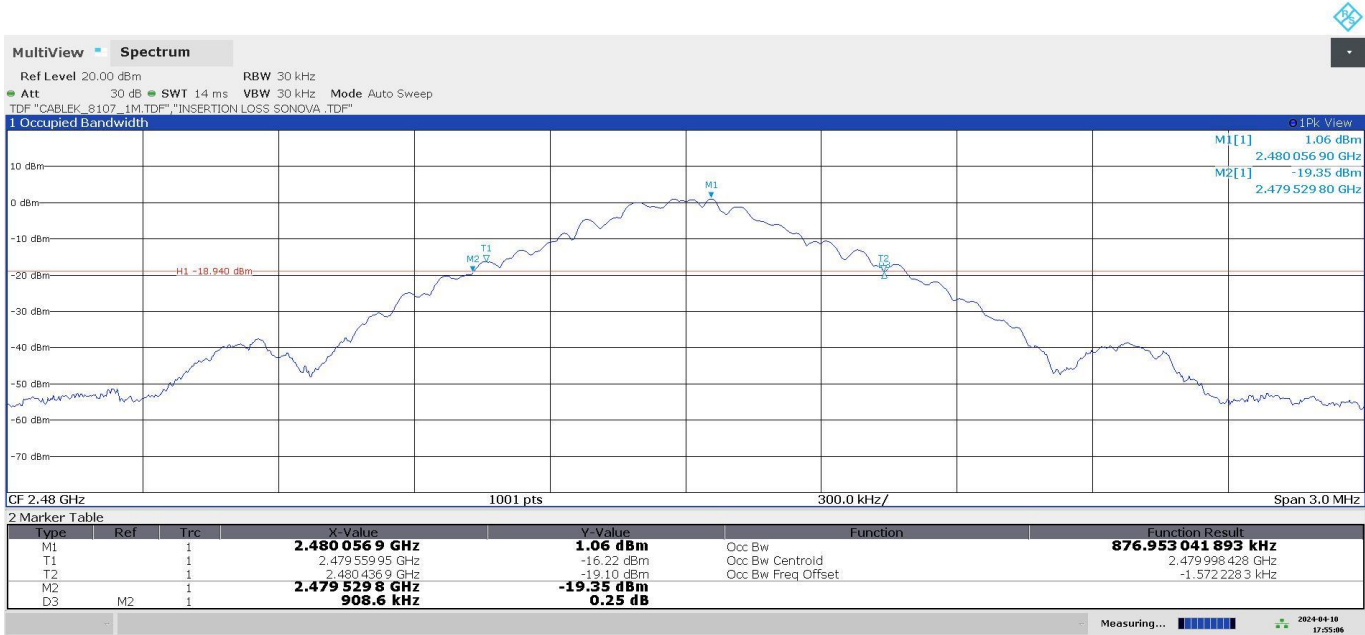
Images:



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Operation Band MHz = [2400, 2483.5] Modulation = BT (GFSK 1-DH5)
Frequency MHz = 2480.00000

Images:



05:55:06 PM 04/10/2024

Modulation: BT (Pi/4 DQPSK 2-DH5)

Results

Operation Band (MHz)	Equipment	Channel Frequency (MHz)	99% Occupied Bandwidth (MHz)
[2400, 2483.5]	Digital Transmission System (DTS)	2402	1.199730899
[2400, 2483.5]	Digital Transmission System (DTS)	2441	1.198729488
[2400, 2483.5]	Digital Transmission System (DTS)	2480	1.199064675

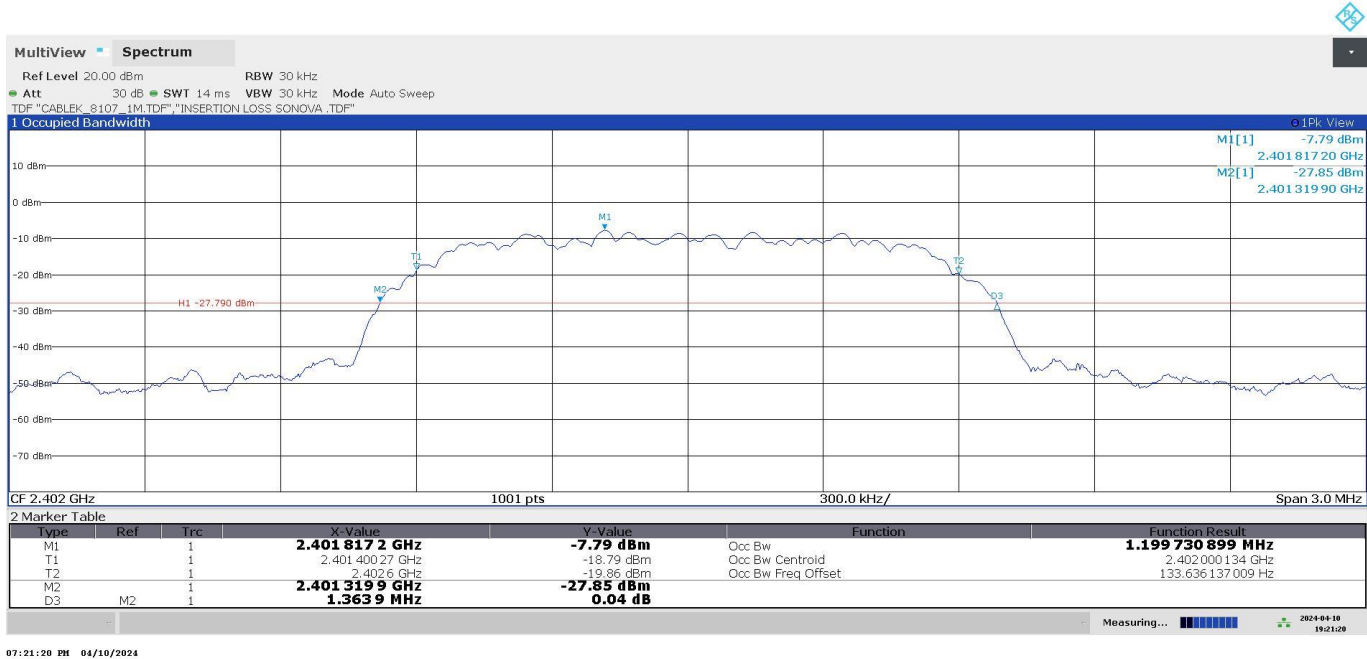
Verdict

Pass

Attachments

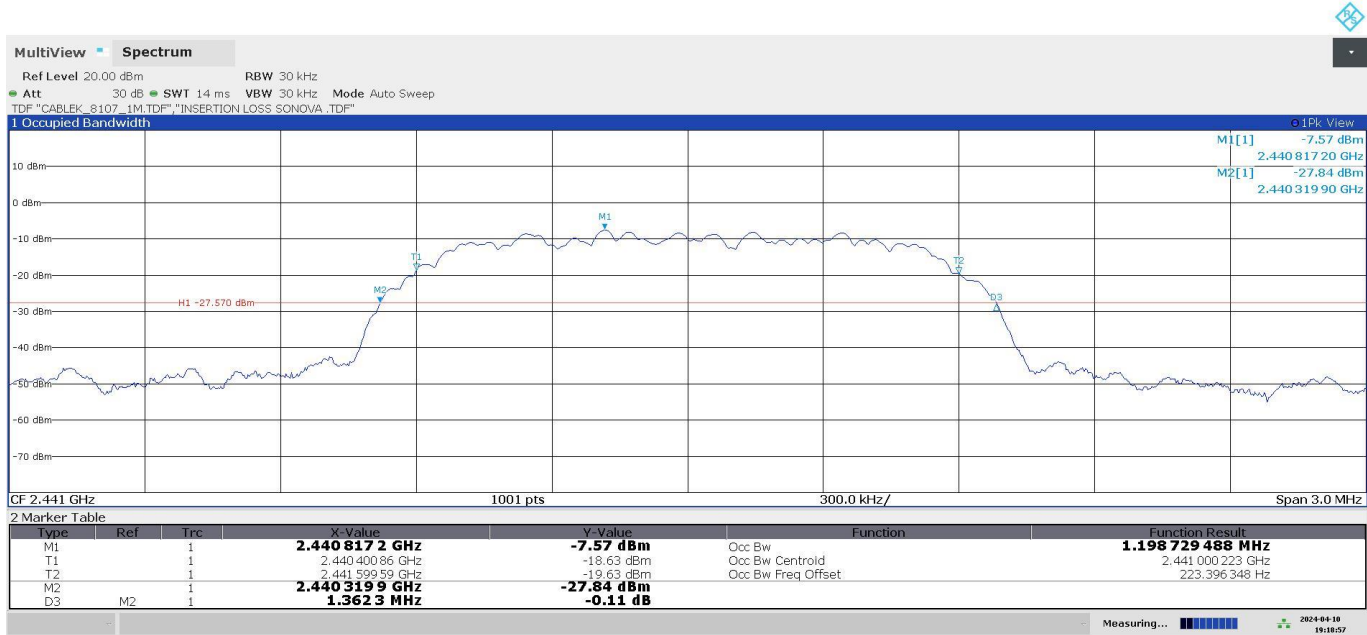
Operation Band MHz = [2400, 2483.5] Modulation = BT (Pi/4 DQPSK 2-DH5)
Frequency MHz = 2402.00000

Images:



Operation Band MHz = [2400, 2483.5] Modulation = BT (Pi/4 DQPSK 2-DH5)
Frequency MHz = 2441.00000

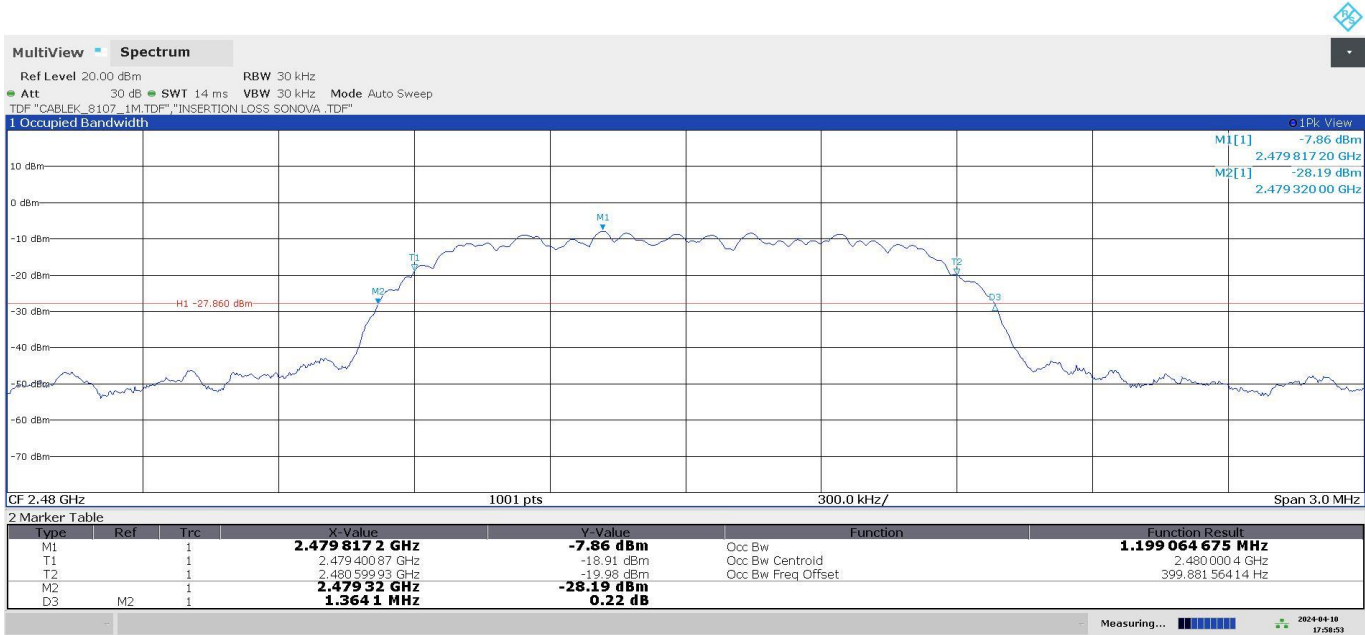
Images:



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Operation Band MHz = [2400, 2483.5] Modulation = BT (Pi/4 DQPSK 2-DH5)
Frequency MHz = 2480.00000

Images:



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Modulation: BT (8DPSK 3-DH5)

Results

Operation Band (MHz)	Equipment	Channel Frequency (MHz)	99% Occupied Bandwidth (MHz)
[2400, 2483.5]	Digital Transmission System (DTS)	2402	1.209666066
[2400, 2483.5]	Digital Transmission System (DTS)	2441	1.209845491
[2400, 2483.5]	Digital Transmission System (DTS)	2480	1.210095333

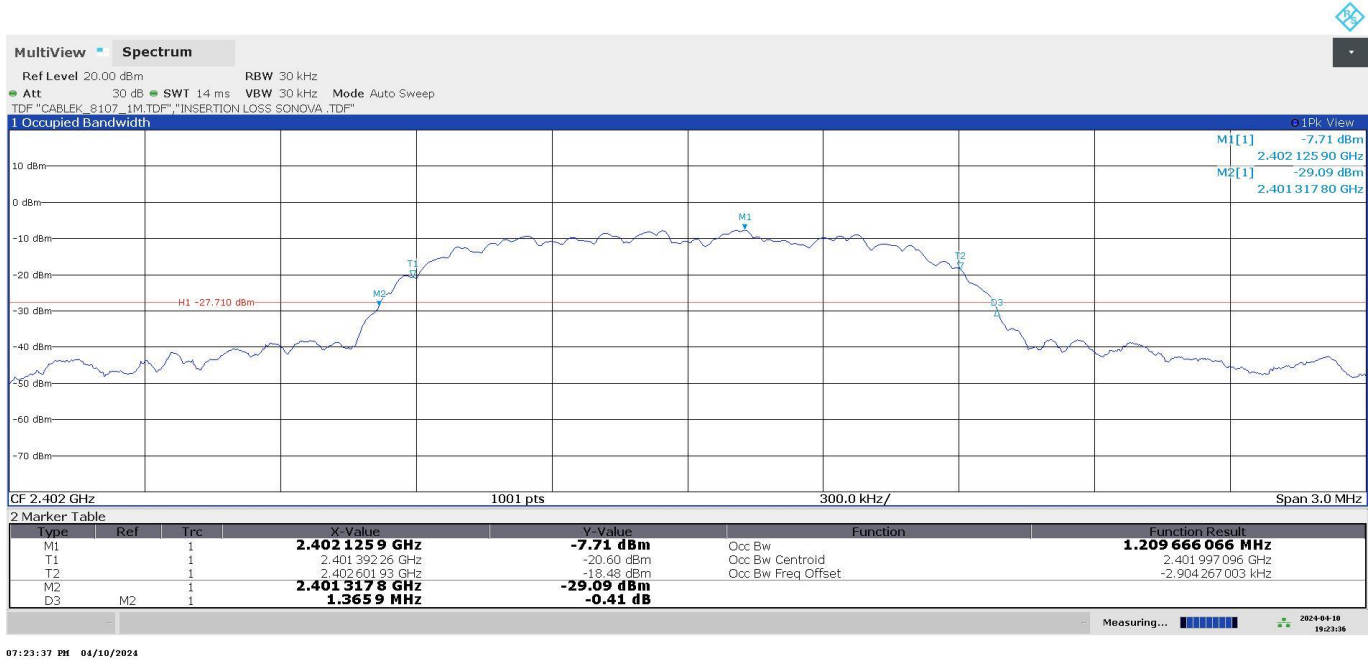
Verdict

Pass

Attachments

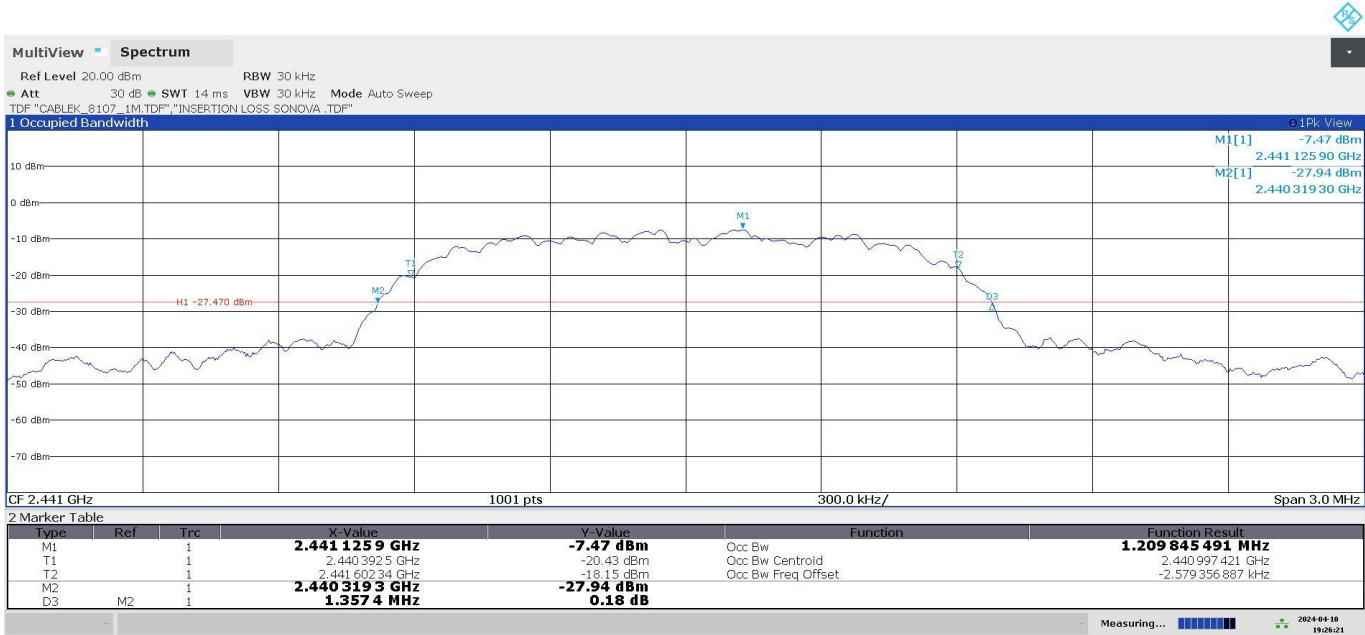
Operation Band MHz = [2400, 2483.5] Modulation = BT (8DPSK 3-DH5)
Frequency MHz = 2402.00000

Images:



Operation Band MHz = [2400, 2483.5] Modulation = BT (8DPSK 3-DH5)
Frequency MHz = 2441.00000

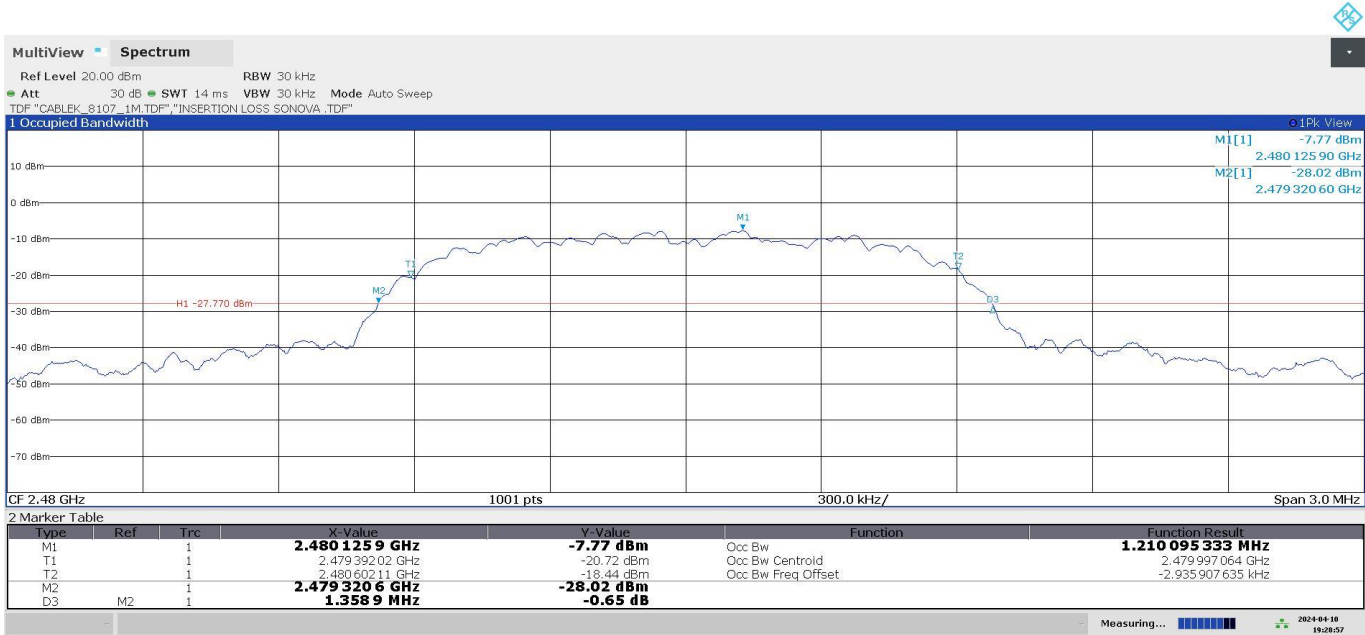
Images:



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Operation Band MHz = [2400, 2483.5] Modulation = BT (8DPSK 3-DH5)
Frequency MHz = 2480.00000

Images:



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Appendix C: Test results. FLORA (Proprietary)

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TEST CONDITIONS

(*): Data provided by the client.

POWER SUPPLY (*):

Vnominal:	3.7 Vdc
Type of Power Supply:	Lithium-ion Rechargeable Battery

ANTENNA (*):

Type of Antenna:	Integral.
Maximum Declared Antenna Gain:	-11 dBi

TEST FREQUENCIES (*):

Low Channel:	2402 MHz
Middle Channel:	2440 MHz
High Channel:	2480 MHz

During transmitter test the EUT was controlled by a SW tool provided by the client to operate in a continuous transmit mode on the modulation schemes and test channels as required.

CONDUCTED MEASUREMENTS:

The equipment under test was set up in a shielded room and it is connected to the TS8997 using a low loss RF cable. The reading of the spectrum analyser is corrected taking into account the cable loss.



RADIATED MEASUREMENTS:

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Bilog antenna for the range between 30 MHz to 1000 MHz and 1 GHz-17 GHz Double ridge horn antenna) is situated at a distance of 3 m and at a distance of 1.5 m for the frequency range 17 GHz-26 GHz (17 GHz-40 GHz horn antenna).

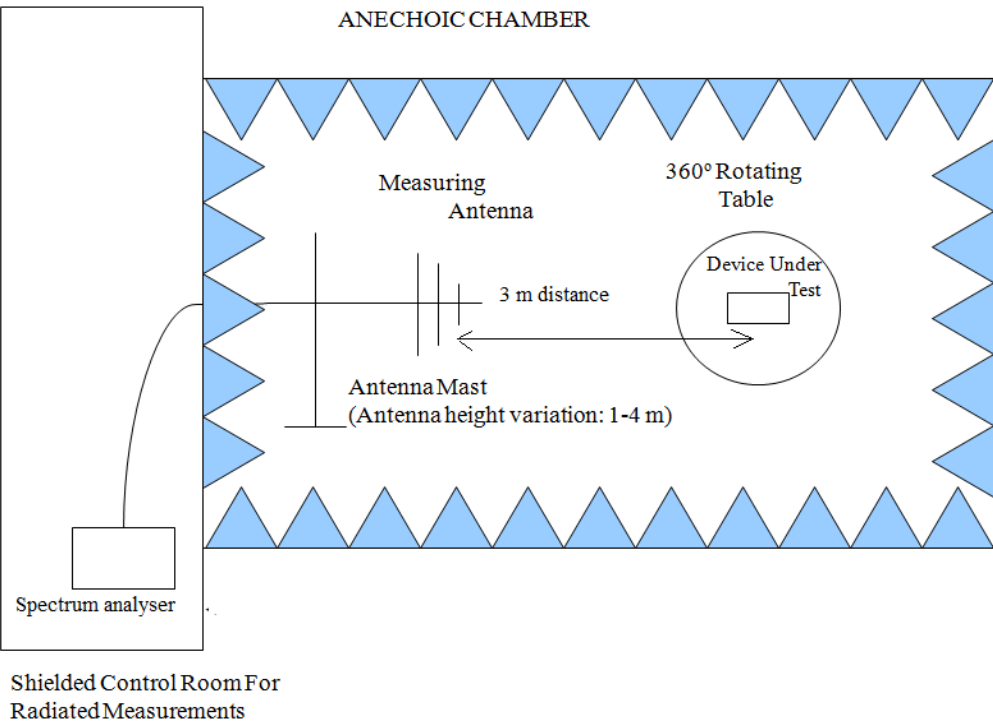
For radiated emissions in the range 17 GHz-26 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height (Bilog antenna and Double ridge horn antenna) was varied from 1 to 4 meters to find the maximum radiated emission.

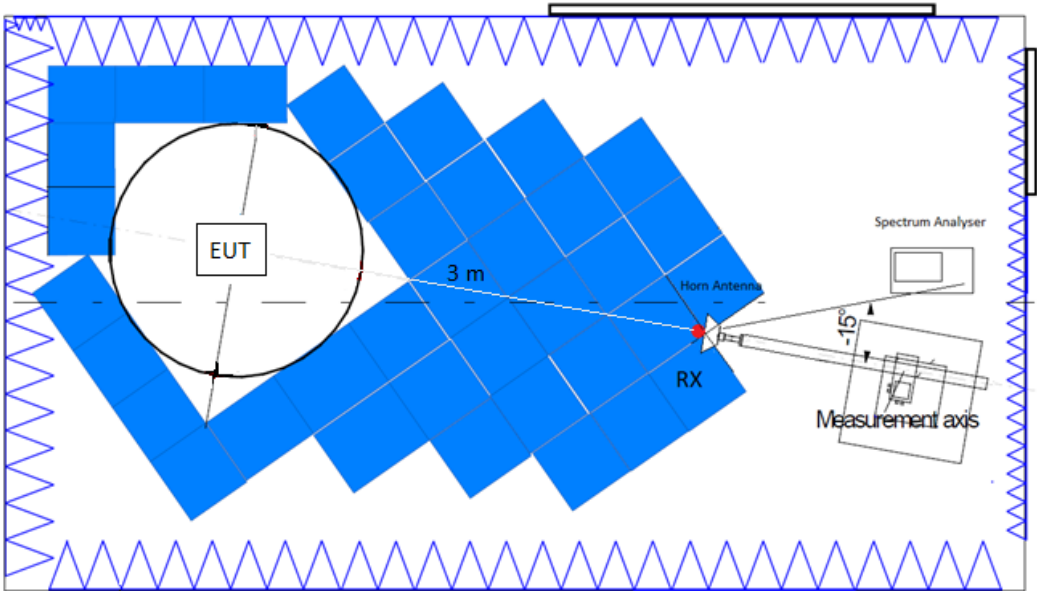
Measurements were made in both horizontal and vertical planes of polarization.

A resolution bandwidth/video bandwidth of 100 kHz / 300 kHz was used for frequencies below 1 GHz and 1 MHz / 3 MHz for frequencies above 1 GHz.

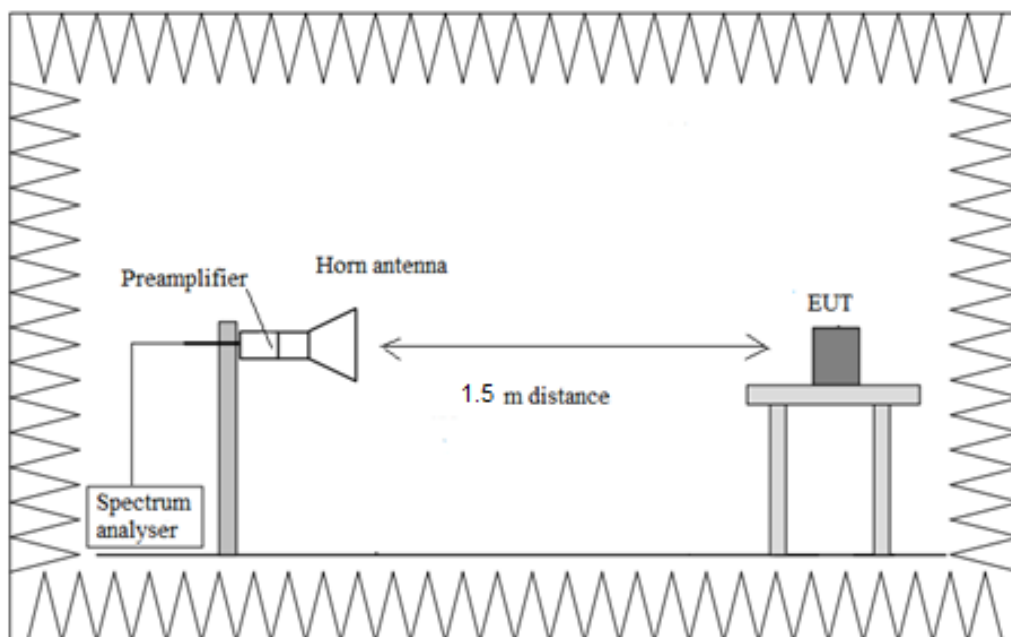
Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1 GHz to 17 GHz:



Radiated measurements setup $f > 17$ GHz:



TEST CASES DETAILS

15.249 (b) / RSS-210 B.10 (a) Field strength of fundamental and harmonics emissions

Limits

The field strength of emissions from intentional radiators shall comply with the following:

Fundamental frequency (MHz)	Field strength of fundamental (mV/m)	Field strength (dBµV/m)	Measurement distance (m)
902 - 928	50	93.98	3
2400 - 2483.5	50	93.98	3
5725 - 5875	50	93.98	3
24000 - 24250	250	107.96	3

For frequencies above 1000 MHz, the above field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

Modulation: Flora

Results

Operation Band (MHz)	Modulation	Channel Frequency (MHz)	Peak Field (dBµV/m)
[2400, 2483.5]	Flora	2402	89.48
[2400, 2483.5]	Flora	2440	91.26
[2400, 2483.5]	Flora	2480	93.13

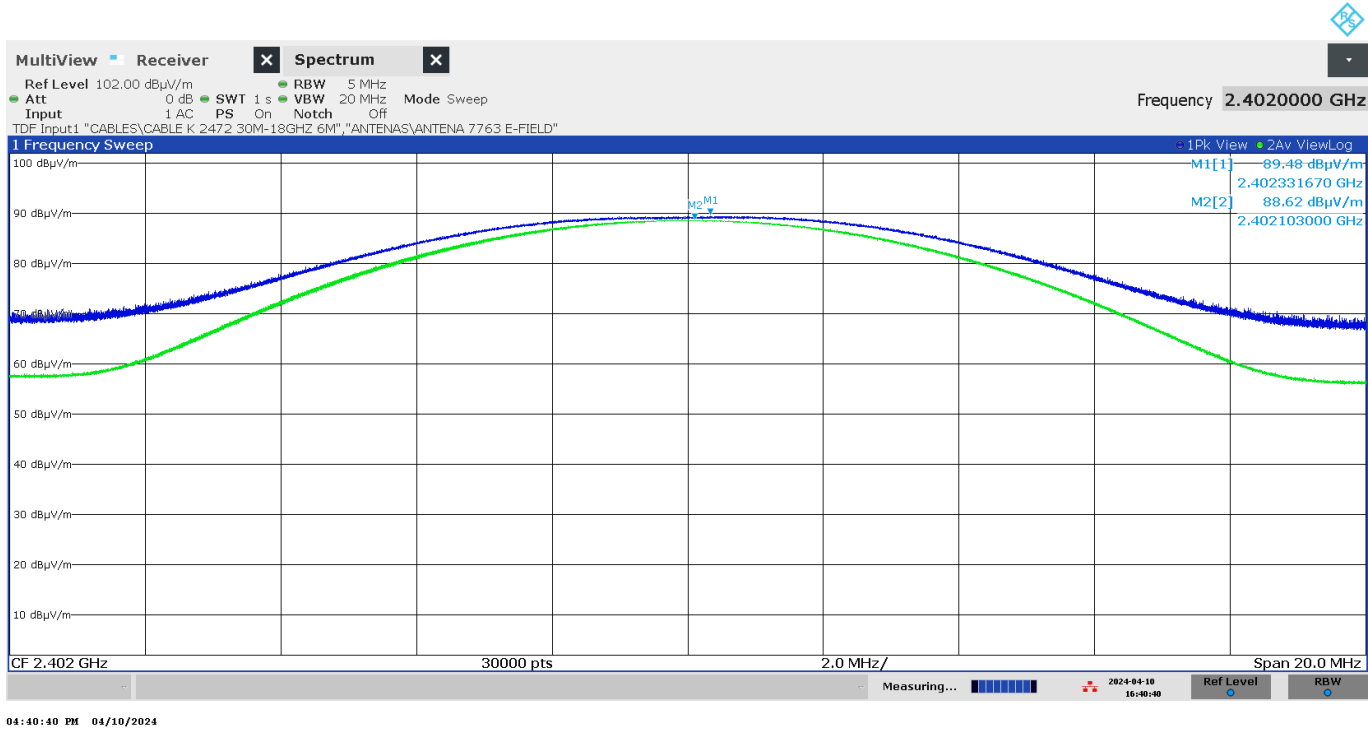
Verdict

Pass

Attachments

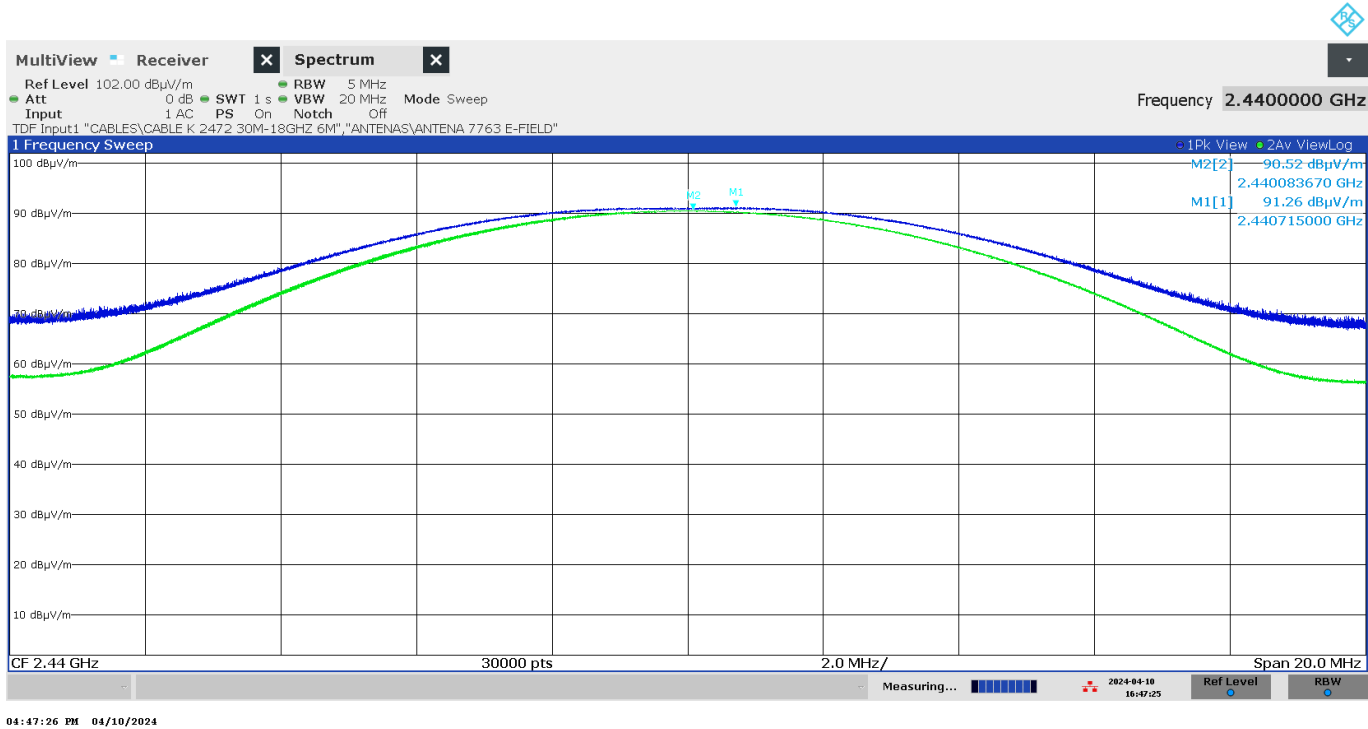
Operation Band MHz = [2400, 2483.5] Modulation = Flora
Frequency MHz = 2402.00000

Images:



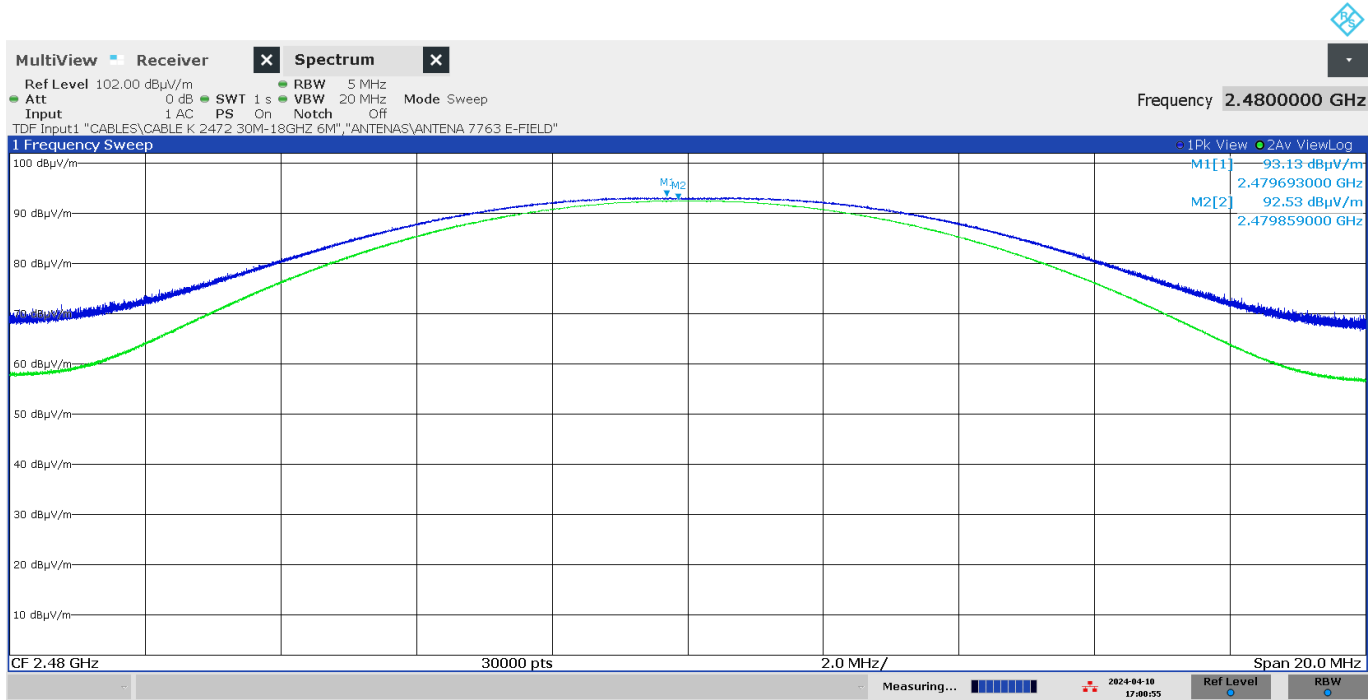
Operation Band MHz = [2400, 2483.5] Modulation = Flora
Frequency MHz = 2440.00000

Images:



Operation Band MHz = [2400, 2483.5] Modulation = Flora
Frequency MHz = 2480.00000

Images:



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15.249 (d) (e) / RSS-210 B.10 (b) Emissions radiated outside of the specific frequency bands

Limits

The field strength of harmonics from intentional radiators shall comply with the following:

Fundamental frequency (MHz)	Field strength of harmonics ($\mu\text{V/m}$)	Field strength of harmonics ($\text{dB}\mu\text{V/m}$)	Measurement distance (m)
902 - 928	500	54	3
2400 - 2483.5	500	54	3
5725 - 5875	500	54	3
24000 - 24250	2500	67.96	3

Emissions radiated outside of the specific frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of fundamental or to the general radiated emission limits specified in section 15.209:

Frequency Range (MHz)	Field strength ($\mu\text{V/m}$)	Field strength ($\text{dB}\mu\text{V/m}$)	Measurement distance (m)
0.009 - 0.490	2400/F(kHz)	-	300
0.490 - 1.705	24000/F(kHz)	-	30
1.705 - 30.0	30	-	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
960 - 25000	500	54	3

whichever is the lesser attenuation.

Frequency range tested for Radiated emissions according to section 15.33:

Start frequency: no radiofrequency signal generated in the device found below 10th sub-armonic, no further investigation required.

Stop frequency: it has been performed the radiated spurious emissions until 10th armonic.

Note: Limits in the following graphs regarding 15.247 are based on 15.209 limits in the same way as 15.249. Please, consider labels 15.247 in all the below graphs also valid in this case for 15.249.

Modulation: Flora

Results

No spurious frequencies detected at less than 20 dB below the limit.

Verdict

Pass

Spectrum analyzer parameters

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [ESR 7] 30 MHz - 1 GHz	48,5 kHz	PK+	100 kHz	1 s	20 dB
Receiver: [ESW 44] 1 GHz - 3 GHz	66,667 kHz	PK+ ; AVG	1 MHz	1 s	0 dB
Receiver: [ESW 44] 3 GHz - 17 GHz	500 kHz	PK+ ; AVG	1 MHz	1 s	0 dB
Receiver: [ESW 44] 17 GHz - 26 GHz	500 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

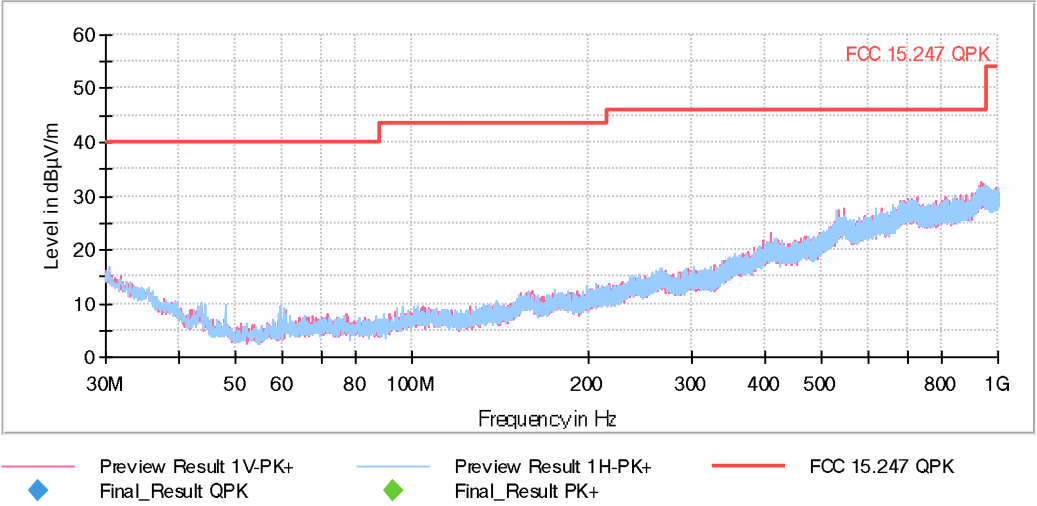
Attachments

Operation Band MHz = [2400, 2483.5] Modulation = Flora

Frequency MHz = 2480.00000

Frequency Range GHz = [0.03, 1]

Images:



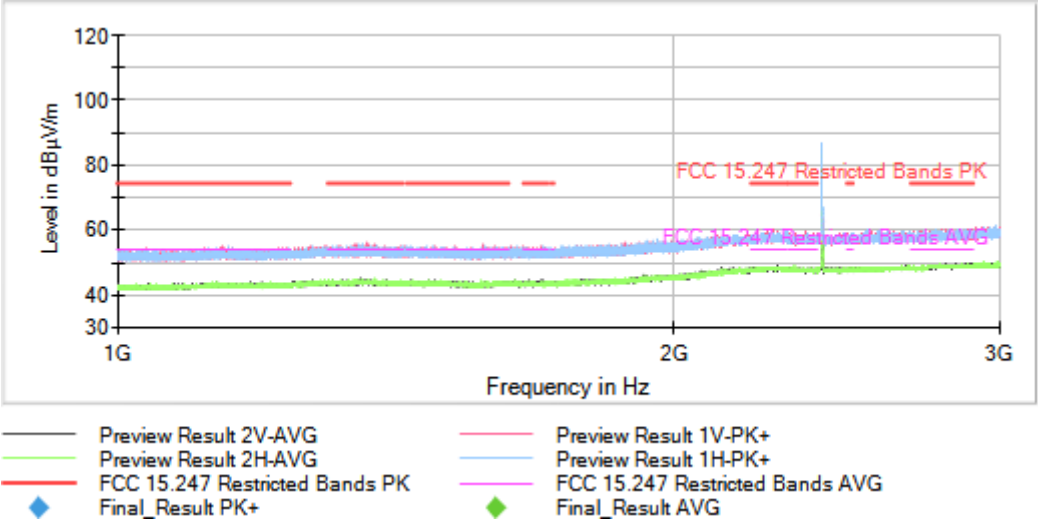
This plot is valid for all channels

Operation Band MHz = [2400, 2483.5] Modulation = Flora

Frequency MHz = 2402.00000

Frequency Range GHz = [1, 3]

Images:

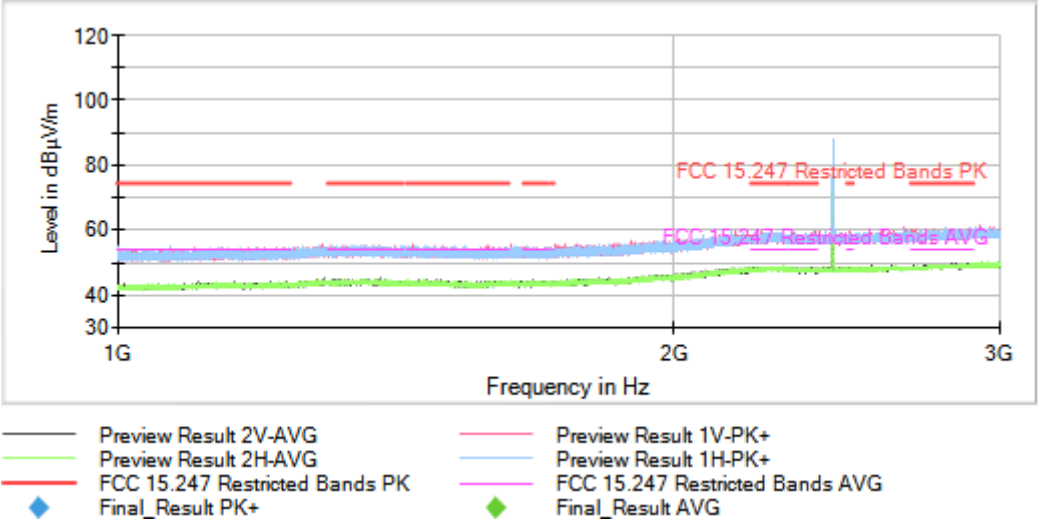


Operation Band MHz = [2400, 2483.5] Modulation = Flora

Frequency MHz = 2440.00000

Frequency Range GHz = [1, 3]

Images:

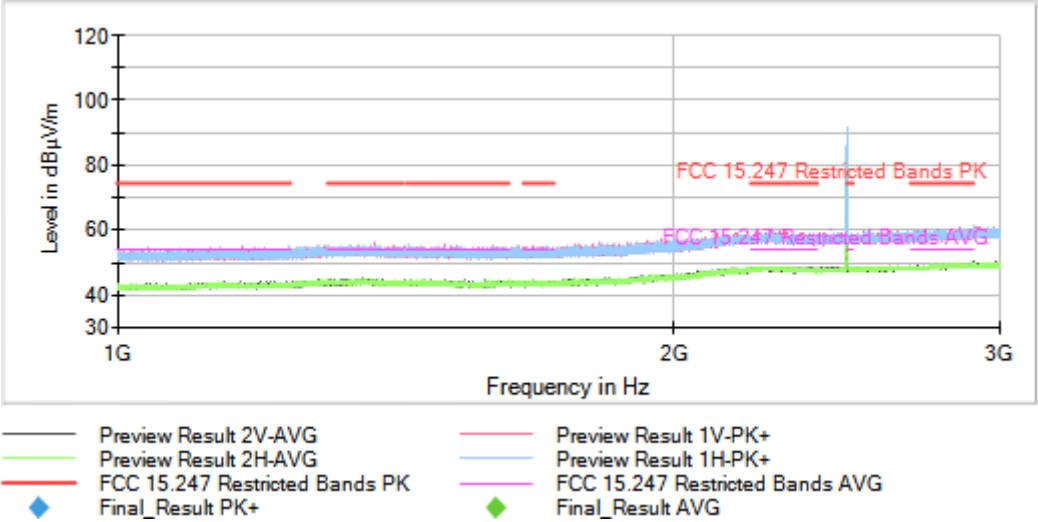


Operation Band MHz = [2400, 2483.5] Modulation = Flora

Frequency MHz = 2480.00000

Frequency Range GHz = [1, 3]

Images:

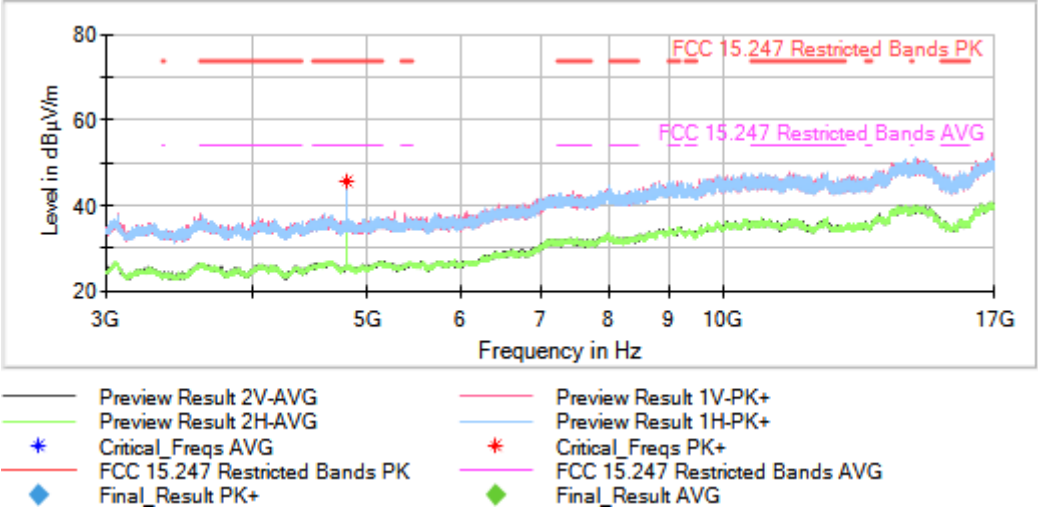


Operation Band MHz = [2400, 2483.5] Modulation = Flora

Frequency MHz = 2402.00000

Frequency Range GHz = [3, 17]

Images:

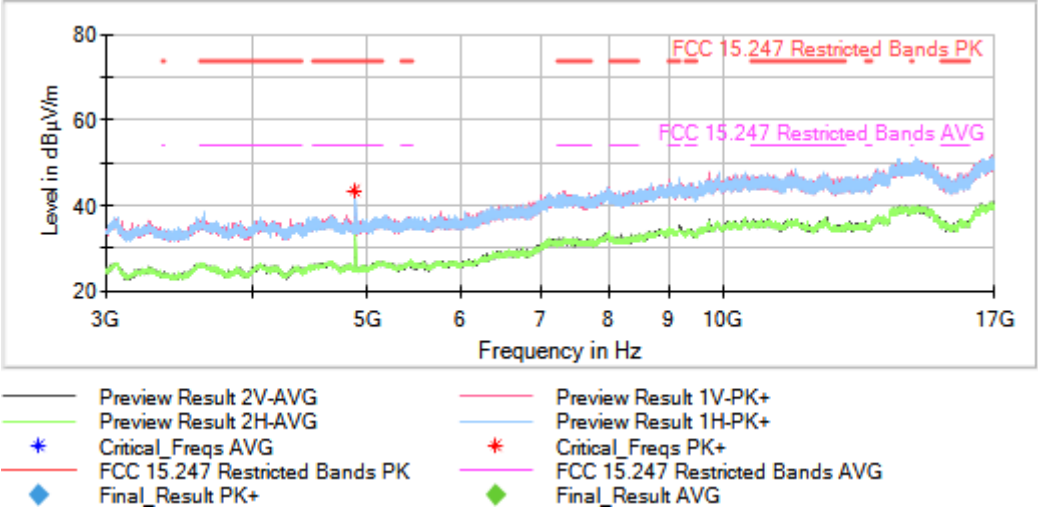


Operation Band MHz = [2400, 2483.5] Modulation = Flora

Frequency MHz = 2440.00000

Frequency Range GHz = [3, 17]

Images:

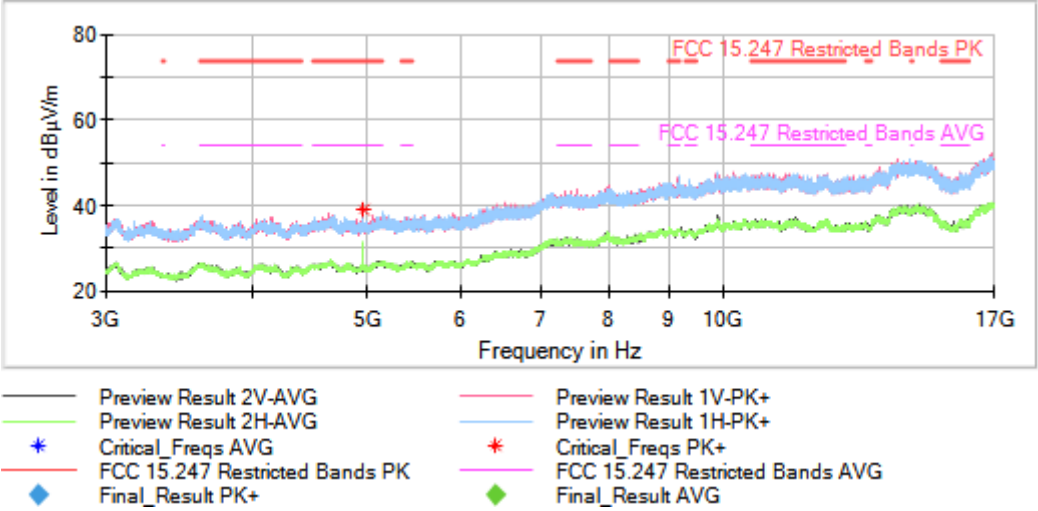


Operation Band MHz = [2400, 2483.5] Modulation = Flora

Frequency MHz = 2480.00000

Frequency Range GHz = [3, 17]

Images:

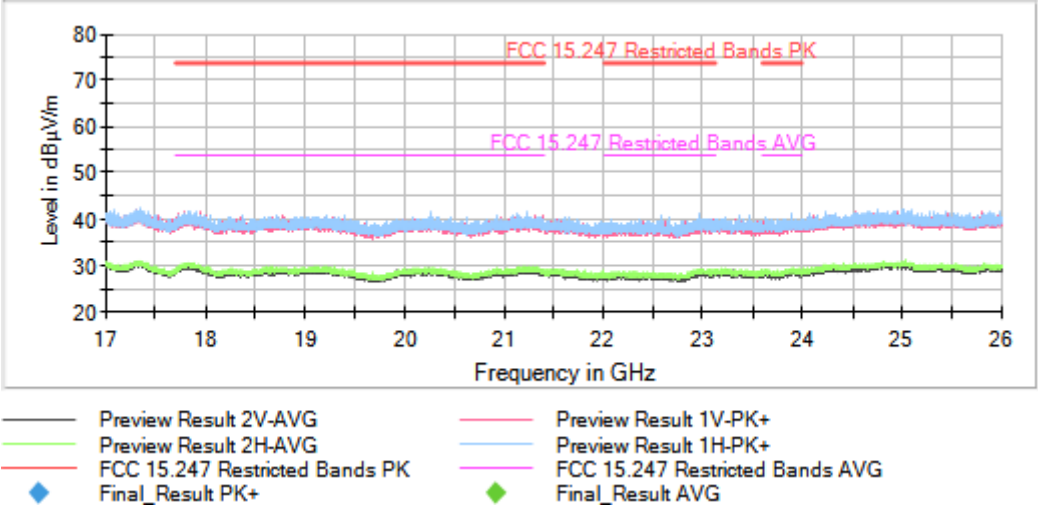


Operation Band MHz = [2400, 2483.5] Modulation = Flora

Frequency MHz = 2402.00000

Frequency Range GHz = [17, 26]

Images:



This plot is valid for all channels

Occupied Channel Bandwidth 99%

Limits

* RSS-Gen Issue 5, Clause 6.7 Occupied bandwidth (or 99% emission bandwidth) and x dB bandwidth:

The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

Modulation: Flora

Results

Operation Band (MHz)	Channel Frequency (MHz)	99% Occupied Bandwidth (MHz)
[2400, 2483.5]	2402	2.668916410
[2400, 2483.5]	2440	2.671105607
[2400, 2483.5]	2480	2.672982761

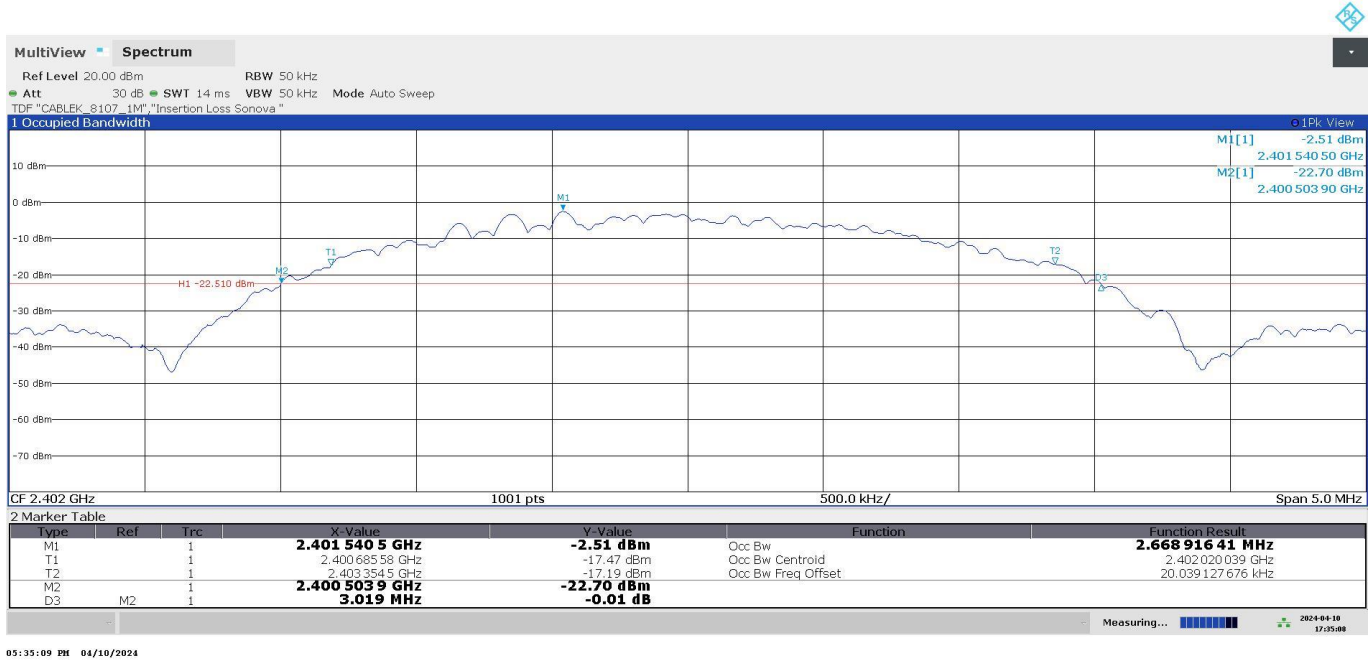
Verdict

Pass

Attachments

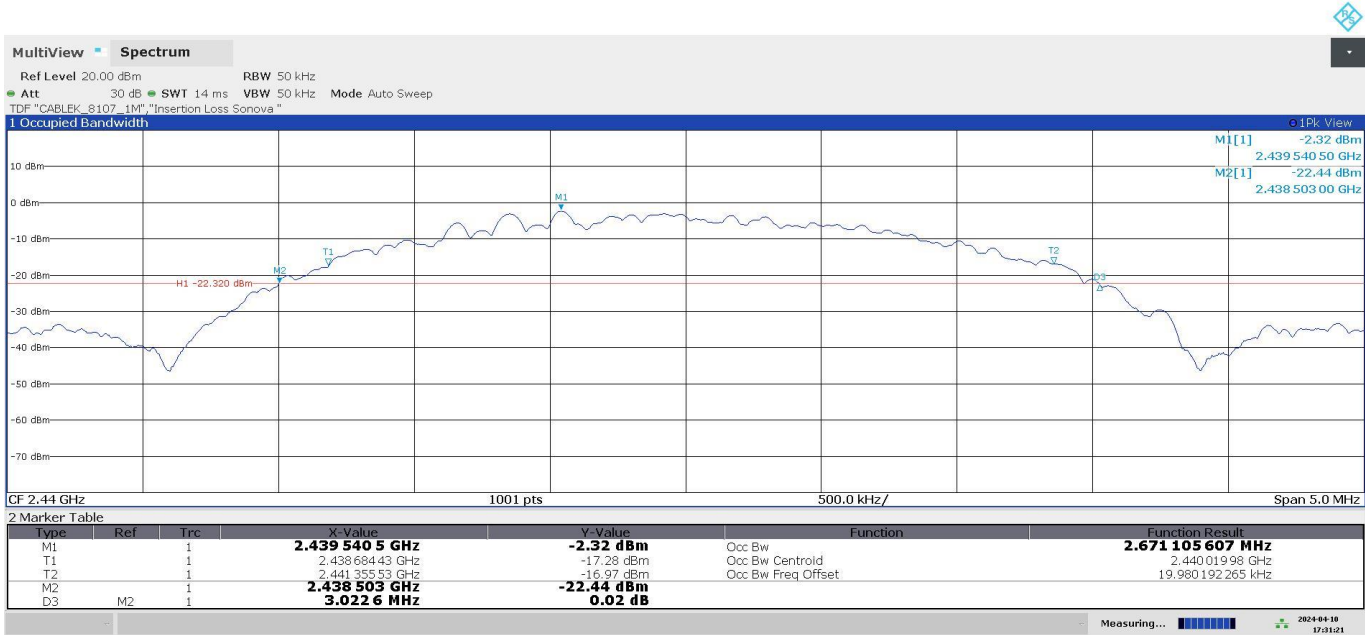
Operation Band MHz = [2400, 2483.5] Modulation = Flora
Frequency MHz = 2402.00000

Images:



Operation Band MHz = [2400, 2483.5] Modulation = Flora
Frequency MHz = 2440.00000

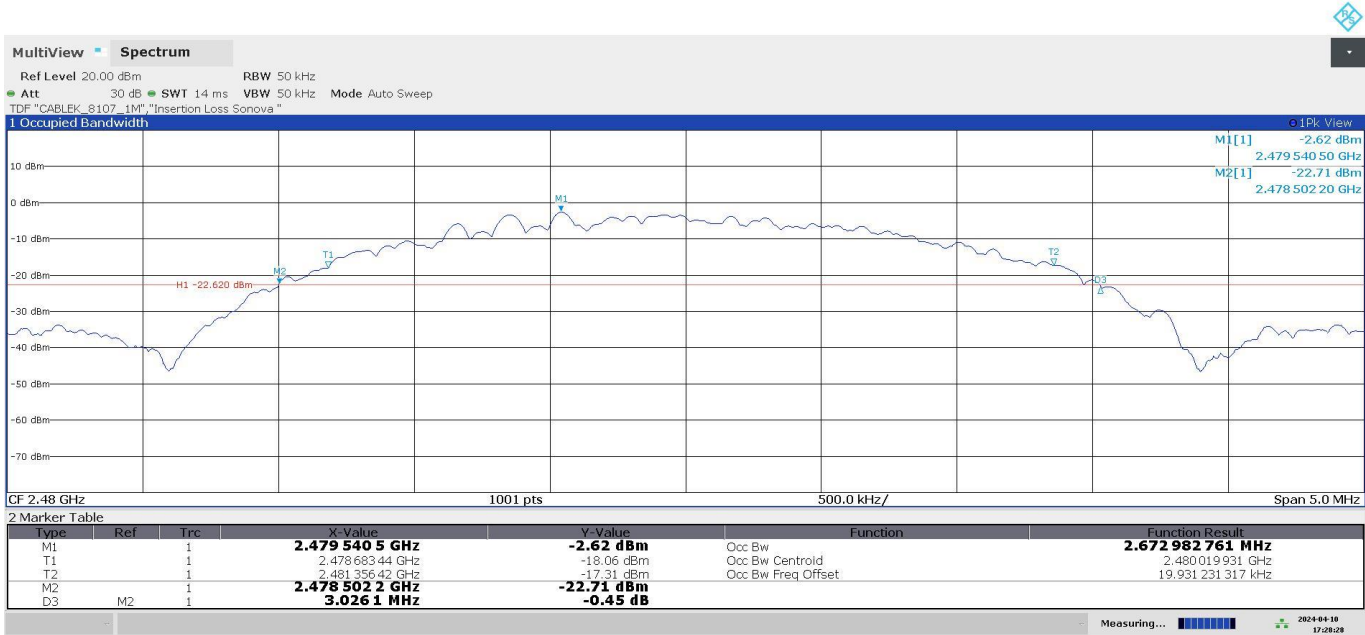
Images:



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Operation Band MHz = [2400, 2483.5] Modulation = Flora
Frequency MHz = 2480.00000

Images:



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Appendix D: Test results. DM (Proprietary)

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TEST CONDITIONS

(*): Data provided by the client.

POWER SUPPLY (*):

Vnominal:	3.7 Vdc
Type of Power Supply:	Lithium-ion Rechargeable Battery

ANTENNA (*):

Type of Antenna:	Integral.
Maximum Declared Antenna Gain:	-11 dBi

TEST FREQUENCIES (*):

Low Channel:	2402 MHz
Middle Channel:	2440 MHz
High Channel:	2480 MHz

During transmitter test the EUT was controlled by a SW tool provided by the client to operate in a continuous transmit mode on the modulation schemes and test channels as required.

CONDUCTED MEASUREMENTS:

The equipment under test was set up in a shielded room and it is connected to the TS8997 using a low loss RF cable. The reading of the spectrum analyser is corrected taking into account the cable loss.



RADIATED MEASUREMENTS:

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Bilog antenna for the range between 30 MHz to 1000 MHz and 1 GHz-17 GHz Double ridge horn antenna) is situated at a distance of 3 m and at a distance of 1.5 m for the frequency range 17 GHz-26 GHz (17 GHz-40 GHz horn antenna).

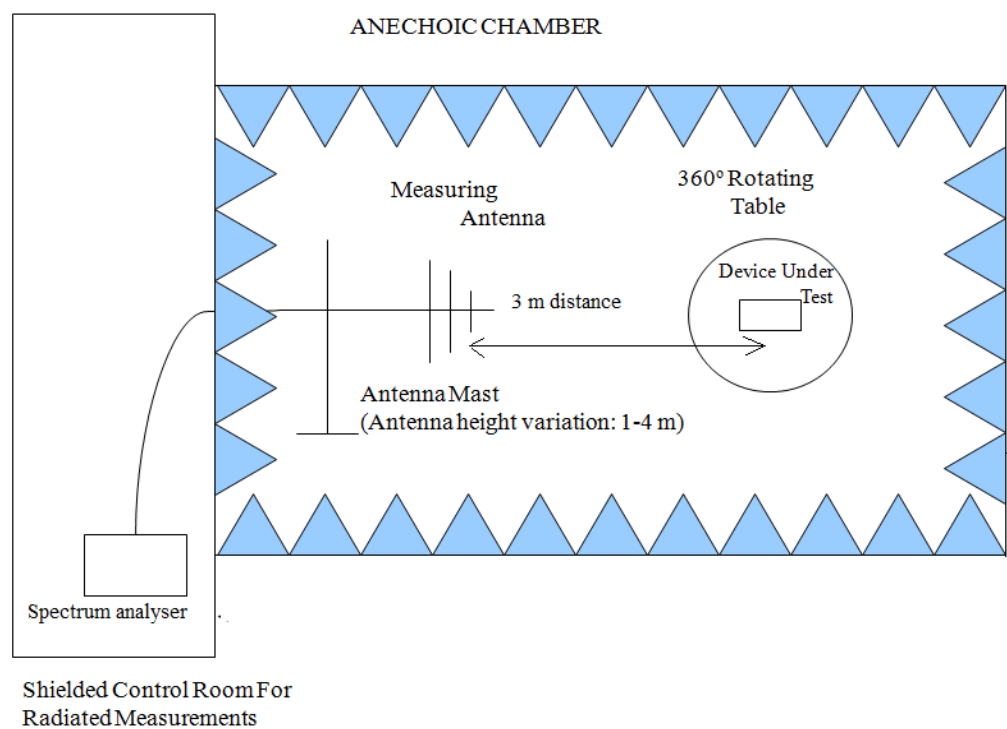
For radiated emissions in the range 17 GHz-26 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height (Bilog antenna and Double ridge horn antenna) was varied from 1 to 4 meters to find the maximum radiated emission.

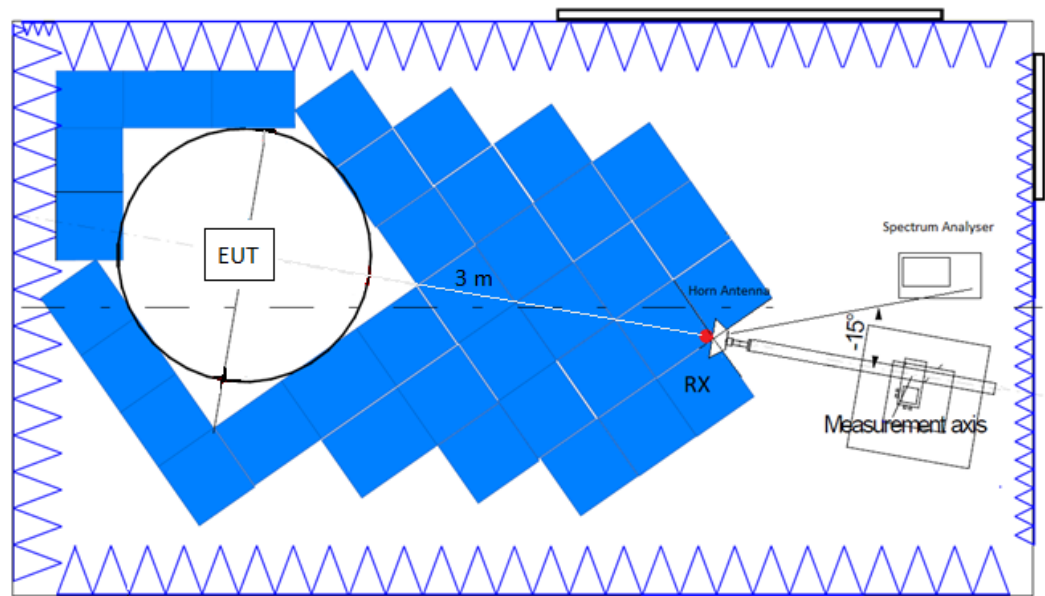
Measurements were made in both horizontal and vertical planes of polarization.

A resolution bandwidth/video bandwidth of 100 kHz / 300 kHz was used for frequencies below 1 GHz and 1 MHz / 3 MHz for frequencies above 1 GHz.

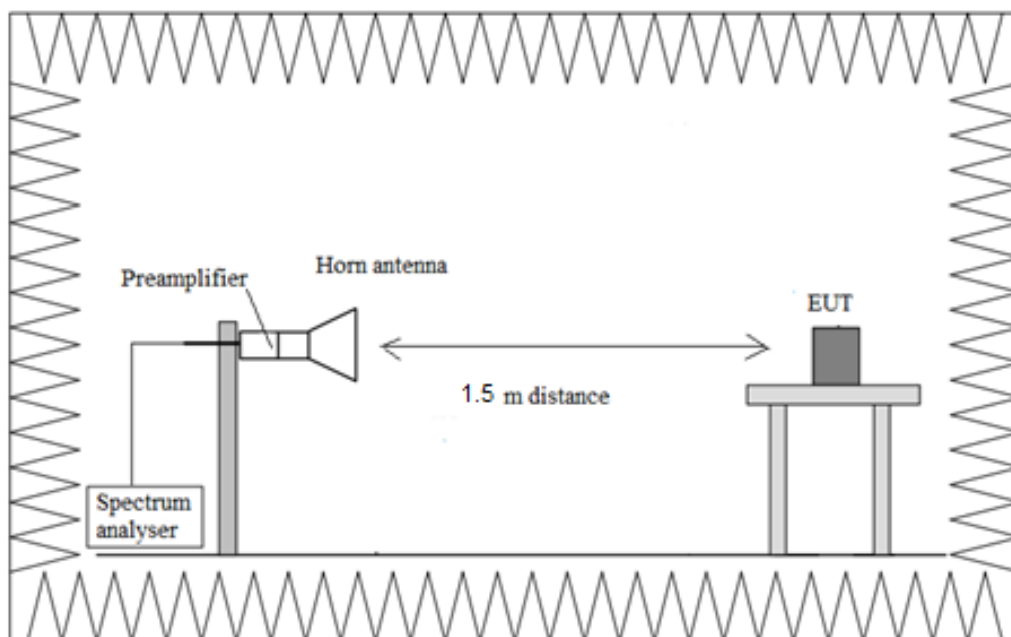
Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1 GHz to 17 GHz:



Radiated measurements setup $f > 17$ GHz:



TEST CASES DETAILS

15.249 (b) / RSS-210 B.10 (a) Field strength of fundamental and harmonics emissions

Limits

The field strength of emissions from intentional radiators shall comply with the following:

Fundamental frequency (MHz)	Field strength of fundamental (mV/m)	Field strength (dBµV/m)	Measurement distance (m)
902 - 928	50	93.98	3
2400 - 2483.5	50	93.98	3
5725 - 5875	50	93.98	3
24000 - 24250	250	107.96	3

For frequencies above 1000 MHz, the above field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

Modulation: DM

Results

Operation Band (MHz)	Modulation	Channel Frequency (MHz)	Peak Field (dBµV/m)
[2400, 2483.5]	DM	2402	84.91
[2400, 2483.5]	DM	2440	86.63
[2400, 2483.5]	DM	2480	88.91

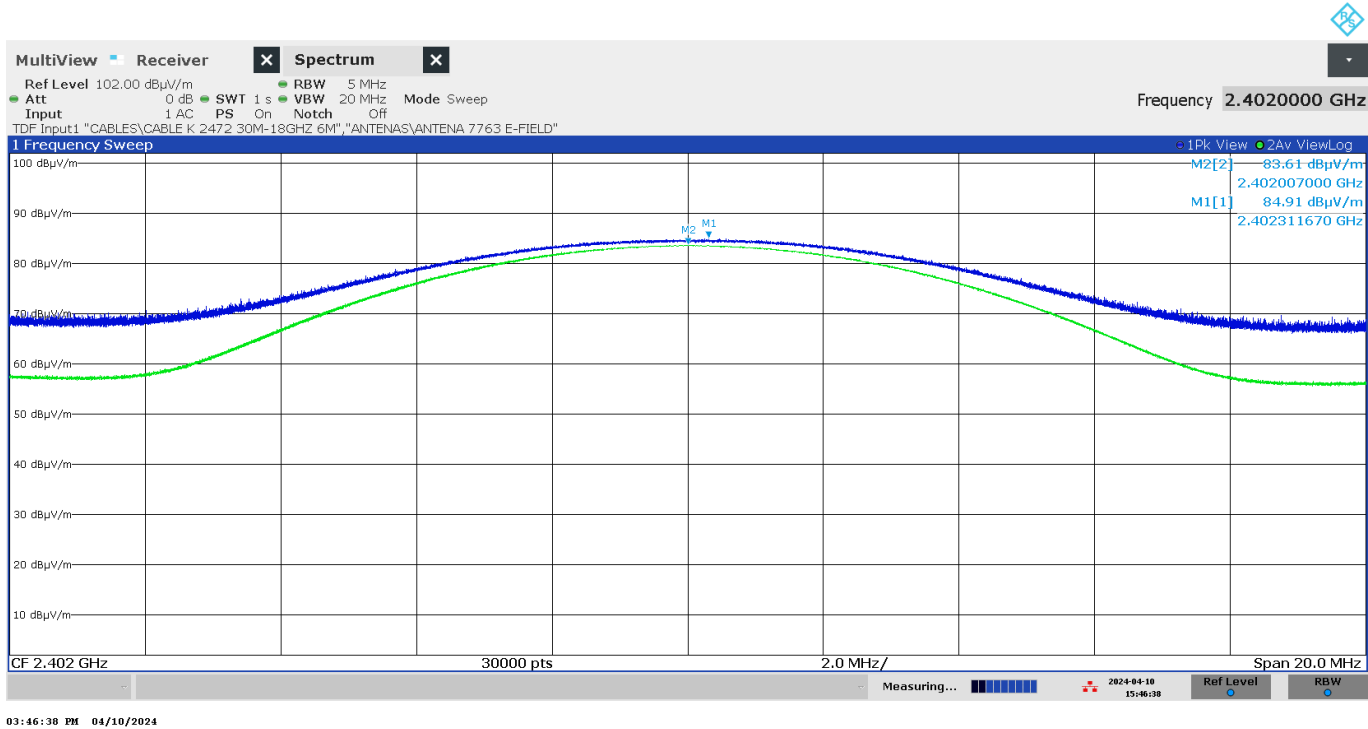
Verdict

Pass

Attachments

Operation Band MHz = [2400, 2483.5] Modulation = DM
Frequency MHz = 2402.00000

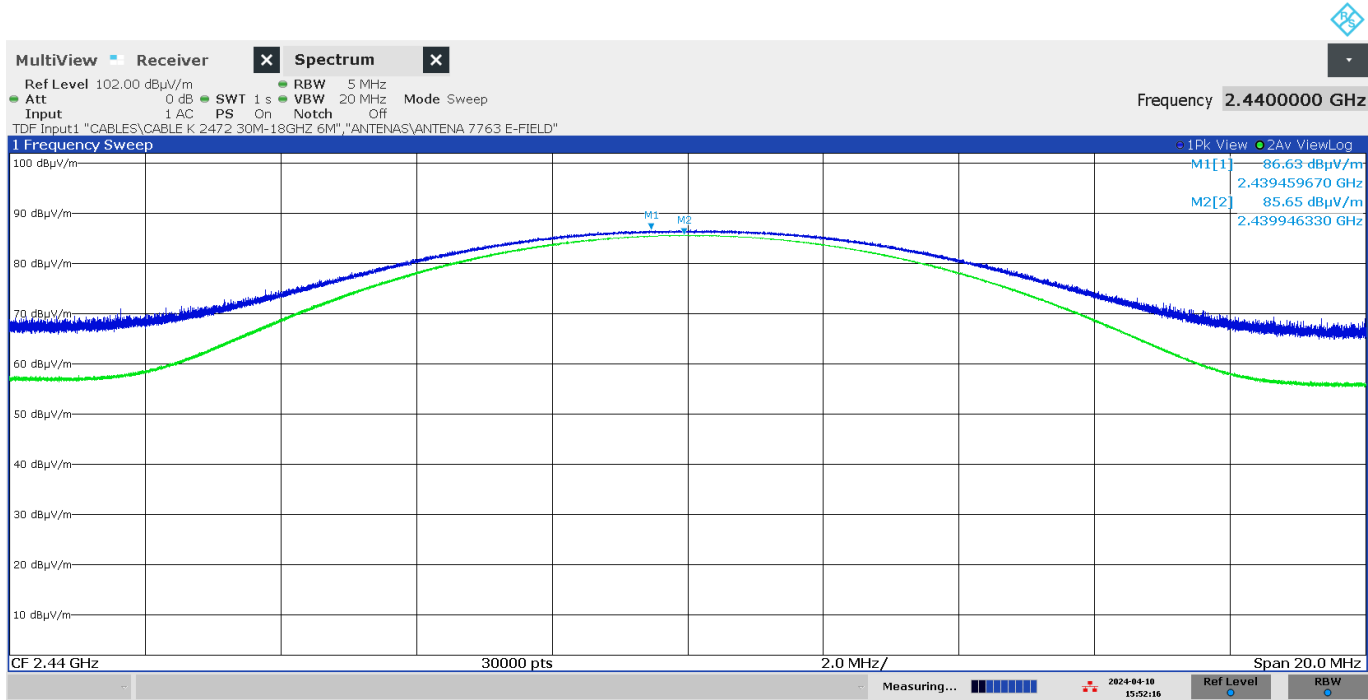
Images:



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Operation Band MHz = [2400, 2483.5] Modulation = DM
Frequency MHz = 2440.00000

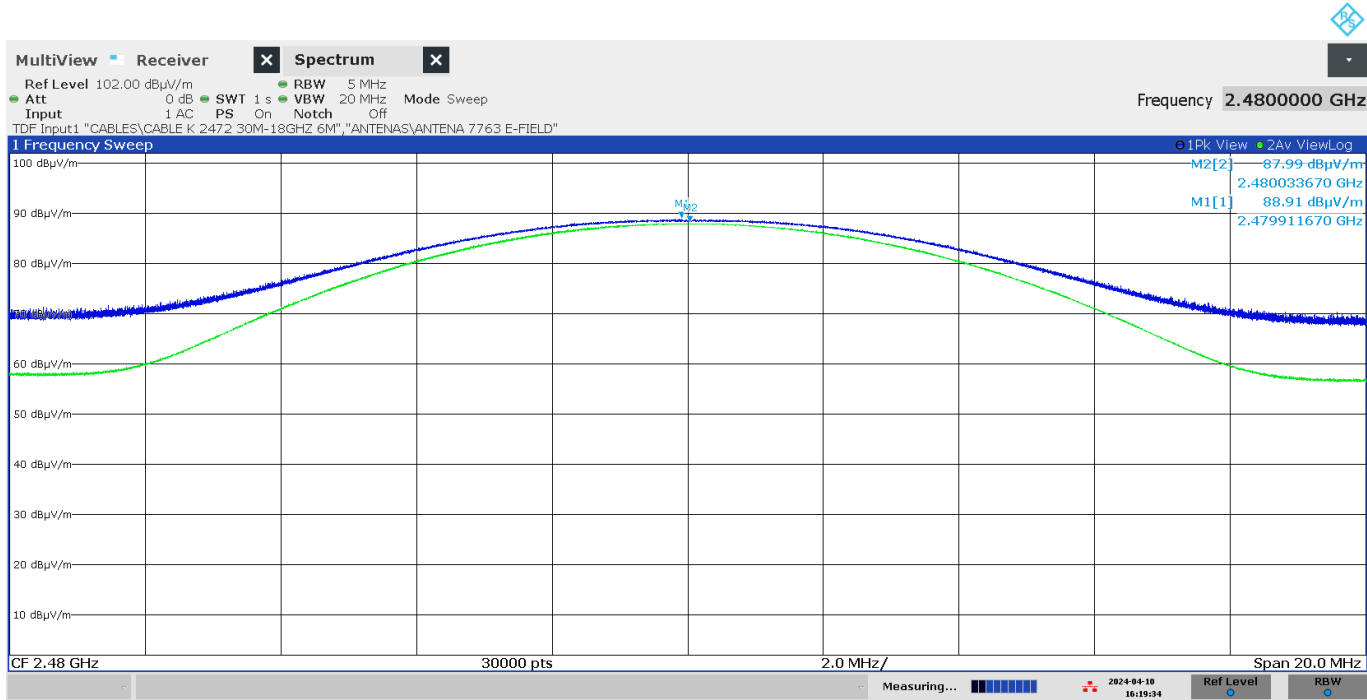
Images:



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Operation Band MHz = [2400, 2483.5] Modulation = DM
Frequency MHz = 2480.00000

Images:



15.249 (d) (e) / RSS-210 B.10 (b) Emissions radiated outside of the specific frequency bands

Limits

The field strength of harmonics from intentional radiators shall comply with the following:

Fundamental frequency (MHz)	Field strength of harmonics (µV/m)	Field strength of harmonics (dBµV/m)	Measurement distance (m)
902 - 928	500	54	3
2400 - 2483.5	500	54	3
5725 - 5875	500	54	3
24000 - 24250	2500	67.96	3

Emissions radiated outside of the specific frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of fundamental or to the general radiated emission limits specified in section 15.209:

Frequency Range (MHz)	Field strength (µV/m)	Field strength (dBµV/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	-	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
960 - 25000	500	54	3

whichever is the lesser attenuation.

Frequency range tested for Radiated emissions according to section 15.33:

Start frequency: no radiofrequency signal generated in the device found below 10th sub-armonic, no further investigation required.

Stop frequency: it has been performed the radiated spurious emissions until 10th armonic.

Note: Limits in the following graphs regarding 15.247 are based on 15.209 limits in the same way as 15.249. Please, consider labels 15.247 in all the below graphs also valid in this case for 15.249.

Modulation: DM

Results

No spurious frequencies detected at less than 20 dB below the limit.

Verdict

Pass

Spectrum analyzer parameters

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [ESR 7] 30 MHz - 1 GHz	48,5 kHz	PK+	100 kHz	1 s	20 dB
Receiver: [ESW 44] 1 GHz - 3 GHz	66,667 kHz	PK+ ; AVG	1 MHz	1 s	0 dB
Receiver: [ESW 44] 3 GHz - 17 GHz	500 kHz	PK+ ; AVG	1 MHz	1 s	0 dB
Receiver: [ESW 44] 17 GHz - 26 GHz	500 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

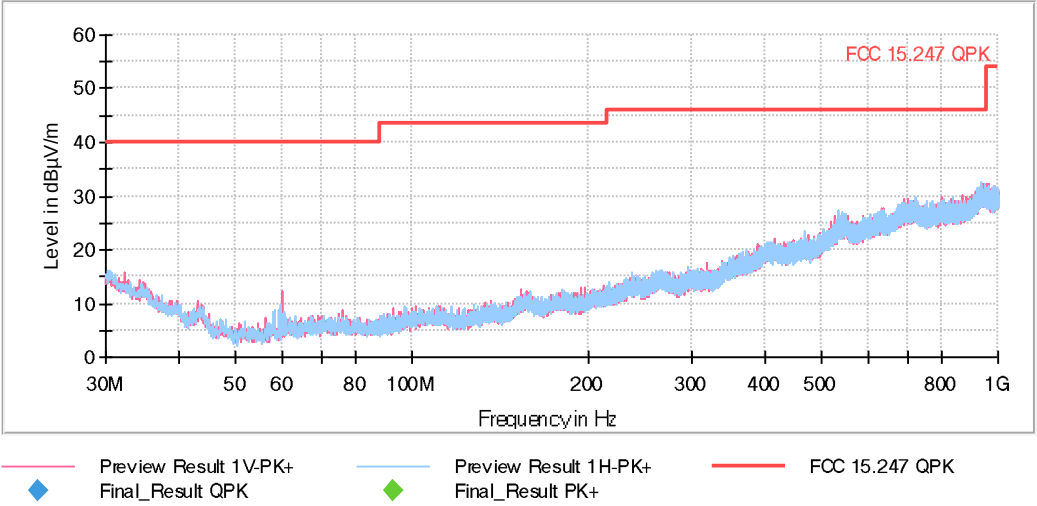
Attachments

Operation Band MHz = [2400, 2483.5] Modulation = DM

Frequency MHz = 2402.00000

Frequency Range GHz = [0.03, 1]

Images:



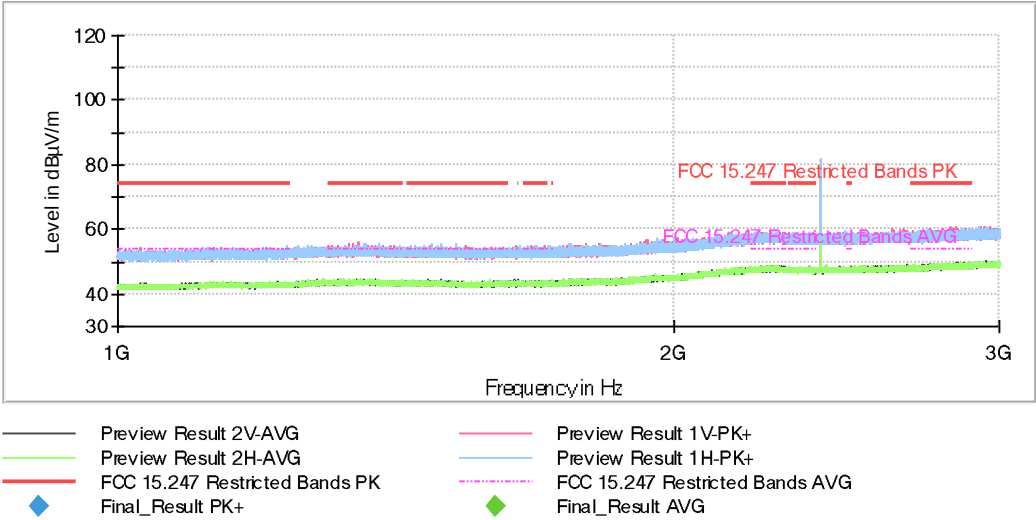
This plot is valid for all channels

Operation Band MHz = [2400, 2483.5] Modulation = DM

Frequency MHz = 2402.00000

Frequency Range GHz = [1, 3]

Images:

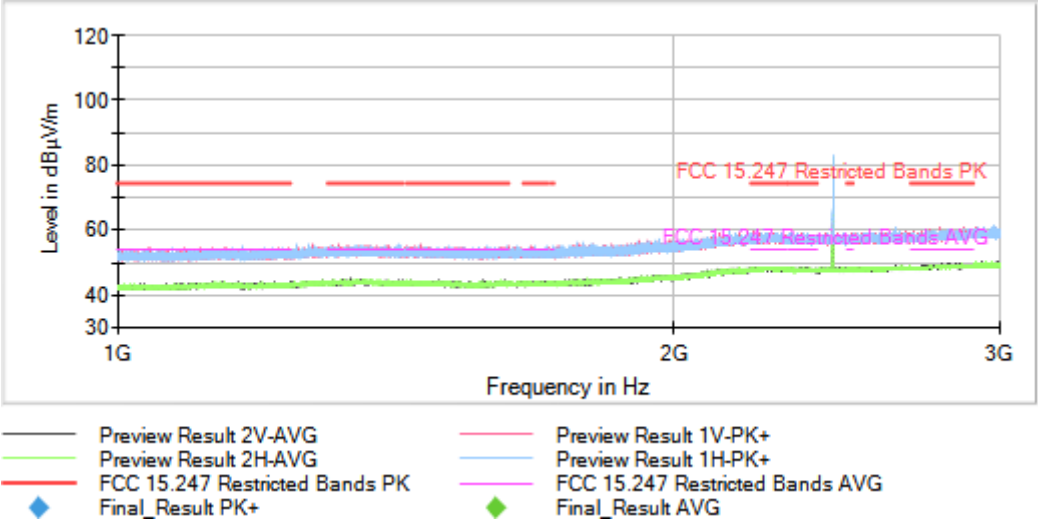


Operation Band MHz = [2400, 2483.5] Modulation = DM

Frequency MHz = 2440.00000

Frequency Range GHz = [1, 3]

Images:

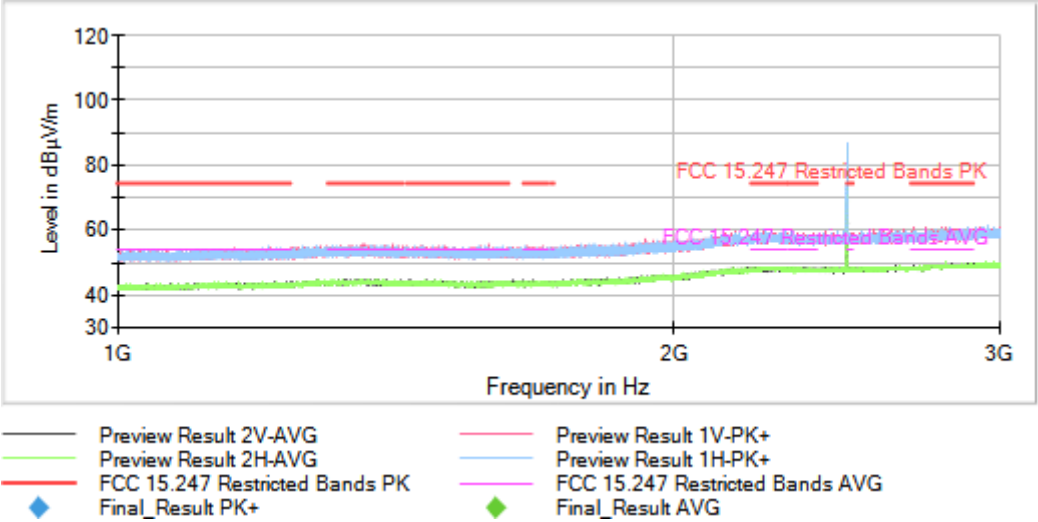


Operation Band MHz = [2400, 2483.5] Modulation = DM

Frequency MHz = 2480.00000

Frequency Range GHz = [1, 3]

Images:

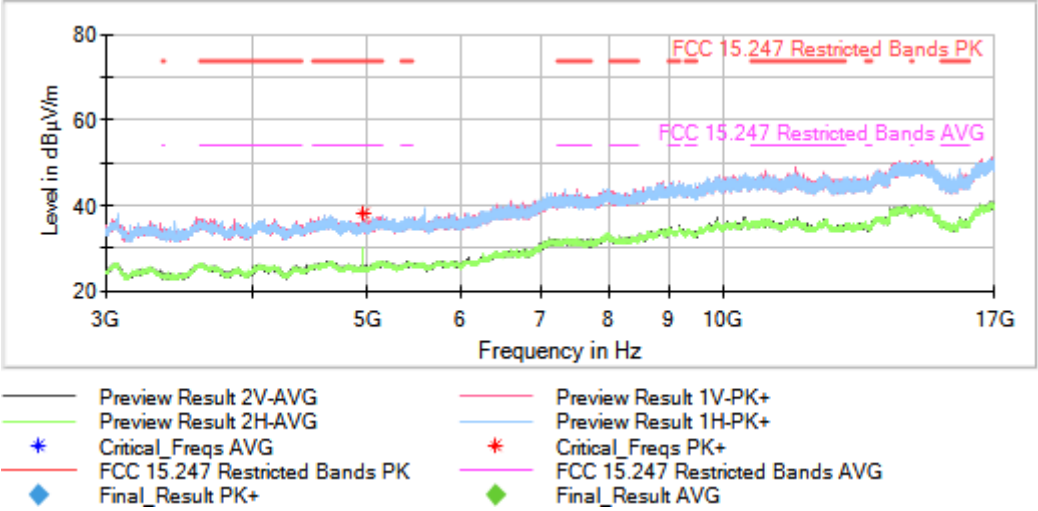


Operation Band MHz = [2400, 2483.5] Modulation = DM

Frequency MHz = 2402.00000

Frequency Range GHz = [3, 17]

Images:

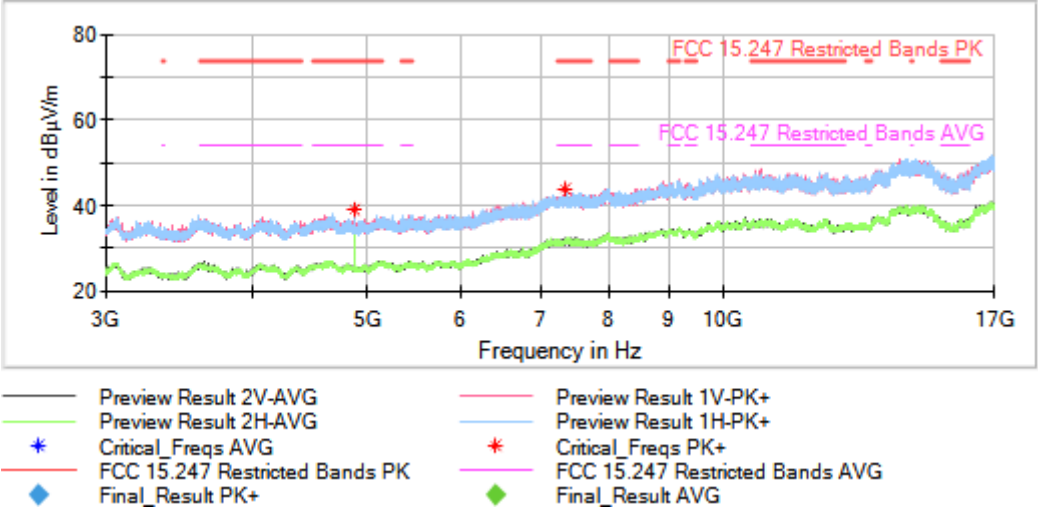


Operation Band MHz = [2400, 2483.5] Modulation = DM

Frequency MHz = 2440.00000

Frequency Range GHz = [3, 17]

Images:

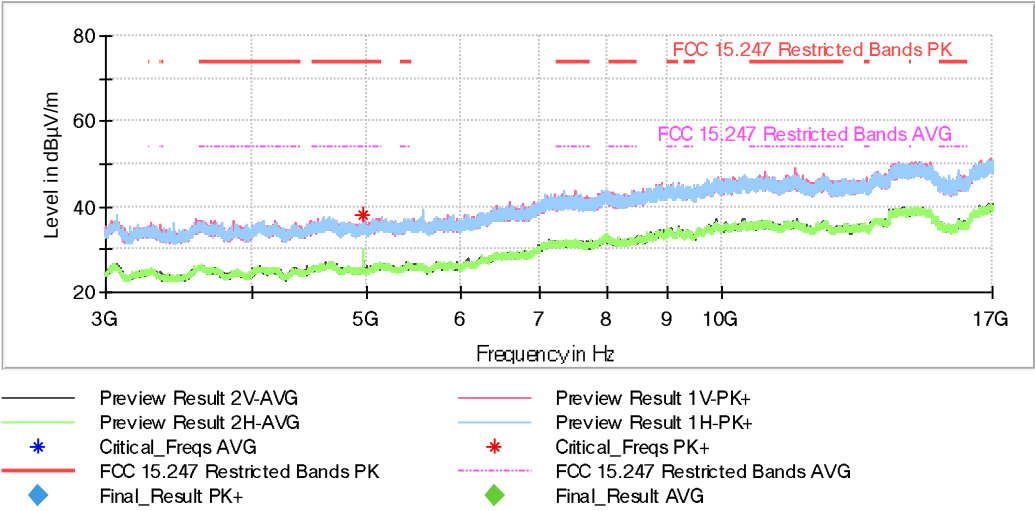


Operation Band MHz = [2400, 2483.5] Modulation = DM

Frequency MHz = 2480.00000

Frequency Range GHz = [3, 17]

Images:

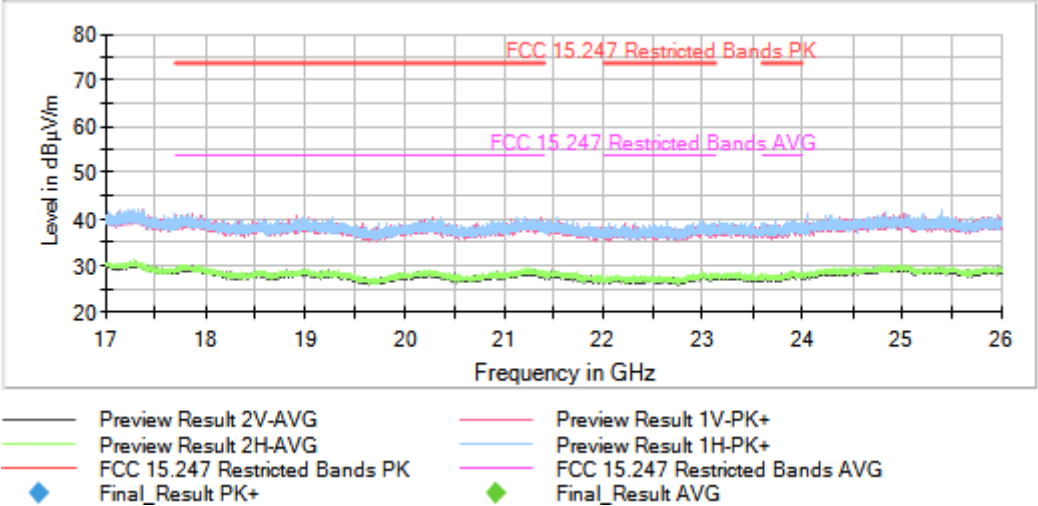


Operation Band MHz = [2400, 2483.5] Modulation = DM

Frequency MHz = 2480.00000

Frequency Range GHz = [17, 26]

Images:



This plot is valid for all channels

Occupied Channel Bandwidth 99%

Limits

* RSS-Gen Issue 5, Clause 6.7 Occupied bandwidth (or 99% emission bandwidth) and x dB bandwidth:

The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

Modulation: DM

Results

Operation Band (MHz)	Channel Frequency (MHz)	99% Occupied Bandwidth (MHz)
[2400, 2483.5]	2402	1.738370153
[2400, 2483.5]	2440	1.735820632
[2400, 2483.5]	2480	1.738710568

Verdict

Pass

Attachments

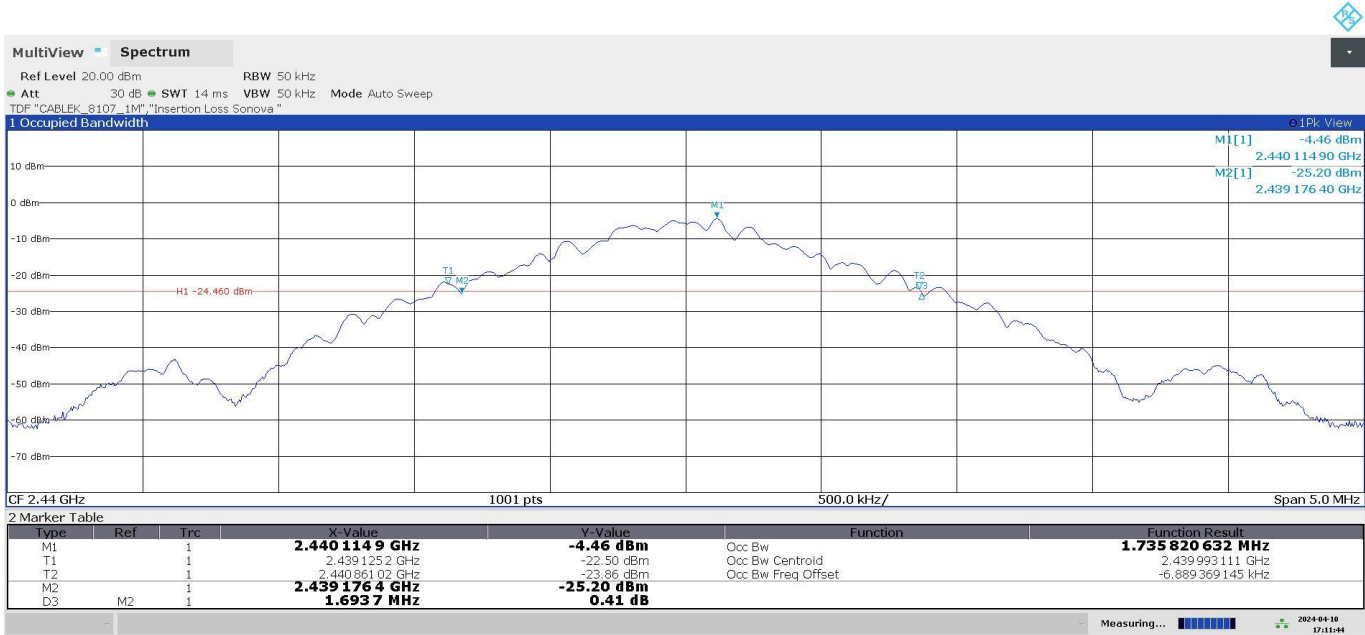
Operation Band MHz = [2400, 2483.5] Modulation = DM
Frequency MHz = 2402.00000

Images:



Operation Band MHz = [2400, 2483.5] Modulation = DM
Frequency MHz = 2440.00000

Images:



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Operation Band MHz = [2400, 2483.5] Modulation = DM
Frequency MHz = 2480.00000

Images:



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