FCC TEST REPORT No. 12/1174	05 November 2012
for 47 CFR Part 15 Subpart C	date of issue

Model name:	Typ-K V2
Product description	Dual Receiver 2.4 Dual FHSS
FCC ID	W3X2754-70
Applicant	weatronic GmbH, Schmiedestr. 2A, D-15745 Wildau, Germany
Manufacturer	weatronic GmbH, Schmiedestr. 2A, D-15745 Wildau, Germany

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Approved by
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Chief TC of PE TC "OMEGA"

Table of contents

1 EQUIPMENT UNDER TEST

1.1 Basic description

Equipment Category	Transceiver
Test item description	Dual Receiver 2.4 Dual FHSS
Model name	Typ-K V2
Serial numbers	370120720021

1.2 Technical characteristics declared by manufacturer

Frequency range	2.400 GHz - 2.4835 GHz
Number of channels	81
Carrier frequency of each channel	2401 + n×1 MHz, n= 0…80
Channel spacing	1 MHz
Maximum output power	20 dBm (100 mW)
Modulation form	FHSS
Modulation type	QPSK
Data rate	1 Mbps
Duty cycle (max.)	25%
Antenna type	Chip on board
Antenna gain	0 dBi
Temperature range	minus 20 ^{o}C to 55 ^{o}C
Supply voltage	3.2 – 10 V DC

1.3 Photos

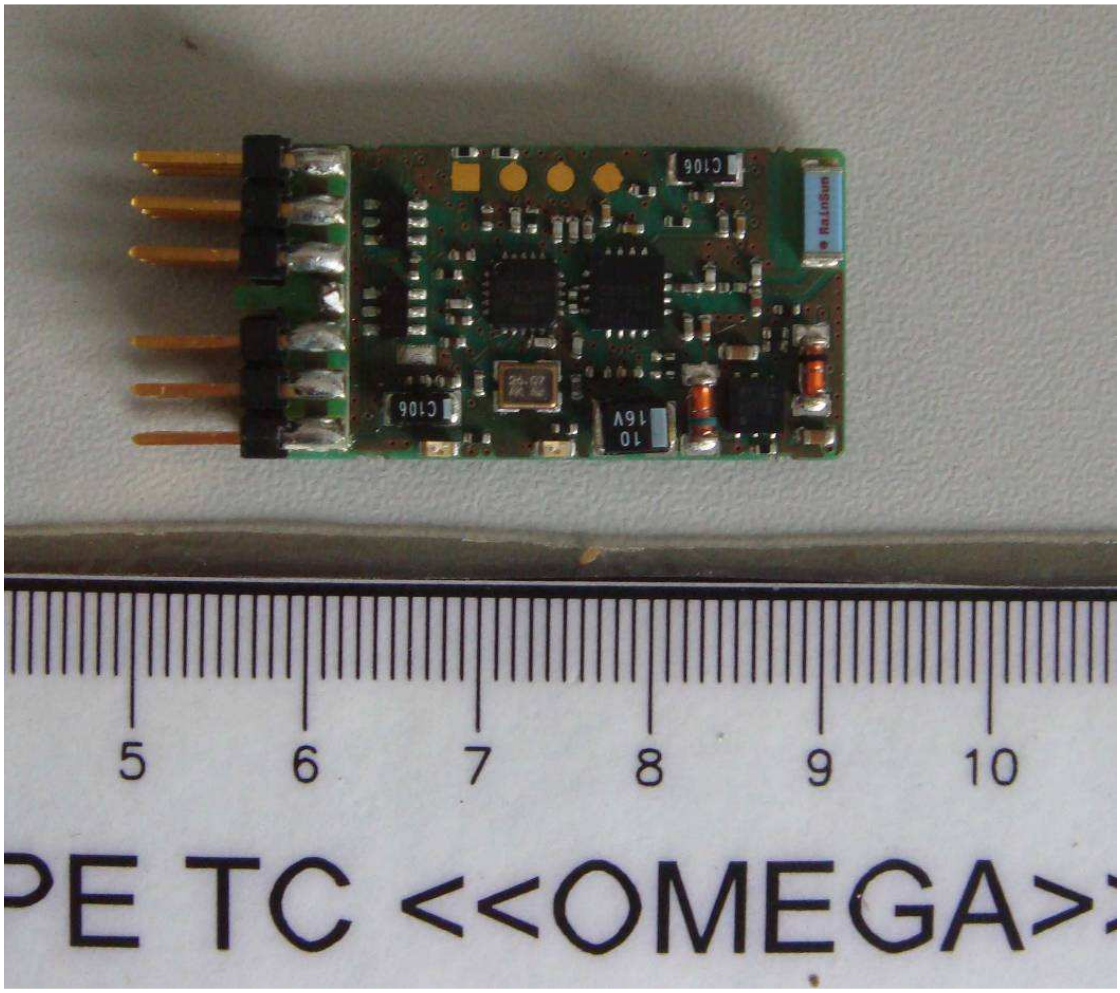


Figure 1 – Model Typ-K V2. Front view.

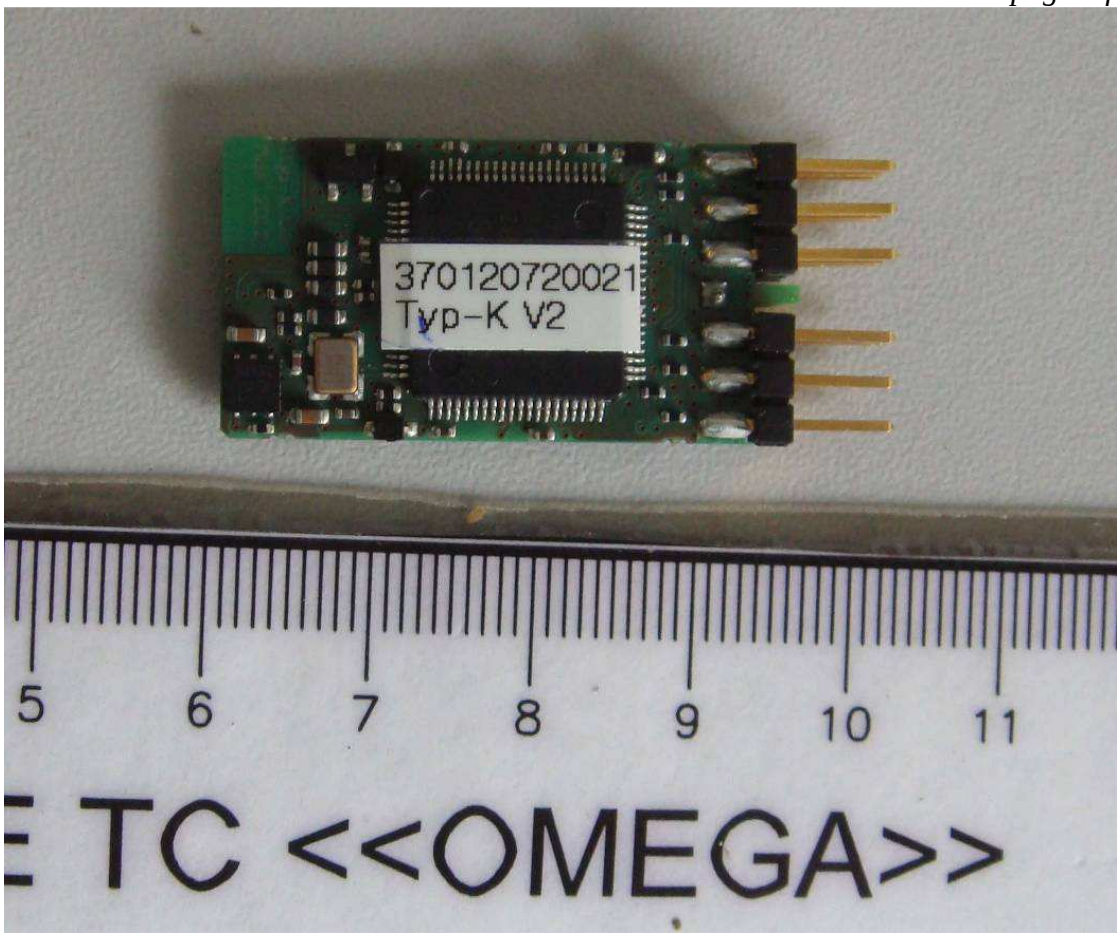


Figure 2 – Model Typ-K V2. Back view.

2 GENERAL INFORMATION ABOUT TESTS

2.1 Test program and results of the tests

Number of test	FCC rule	Description of test	Result (Pass, Fail, N/A)
1	FCC § 15.247 (a)(1) IC RSS-210 A 8.1(b)	Hopping channel separation	Pass
2	FCC § 15.247 (a)(1)(iii) IC RSS-210 A 8.1(b)	Number of hopping frequencies used	Pass
3	FCC § 15.247 (a)(1) IC RSS-210 A 8.2 (a)	Hopping channel bandwidth	Pass
4	FCC § 15.247 (a)(1)(iii) IC RSS-210	Dwell time of each frequency	Pass
5	FCC § 15.247 (b)(1) IC RSS-210 A 8.4 (2)	Output power	Pass
6	FCC § 15.247 (d) IC RSS-210 A 8.5	100 kHz Bandwidth of Frequency Band Edges measurement	Pass
7	FCC § 15.209 IC RSS-210 A 8.5	Radiated Emission from Transmitter Part	Pass
8	FCC § 15.203	Antenna Requirement	Pass
9	FCC § 15.209 IC RSS-210 A 8.5	Radiated Emission from Receiver Part	Pass
10	FCC § 15.247 (h)(i) IC RSS-102 (4.2)	RF exposure	Pass

Tested by:
Laboratory engineer Boris Trifonov

Laboratory engineer Maxim Kozub

Checked by:
Leading engineer Fjodor Shubin

2.2 Test manner

For organization of connection was used ancillary transceiver Typ-D V4.
The test distance of radiated emission from antenna to EUT is 3 m .
Methods of measurement - according to ANSI C63.4-2003.

2.3 Test conditions and test modes

Normal temperature and humidity:
- temperature: from 15 ºC to 35 ºC;
- relative humidity: from 20 % to 75 %

Normal power source:
- Unom = 5 VDC.

The frequencies for the testing

Channel, No.	Frequency, MHz
0	2401
41	2442
80	2481

2.4 Test equipment used

№	Name	Model	Inventory or serial No.
1.	Spectrum analyzer	FSV40	100821
2.	Spectrum analyzer	R&S FSH8	105763
3.	EMI test receiver	R&S ESU-26	100260
4.	Directional coupler	773D	100101
5.	Attenuator	Agilent 8496B	MY42141168
6.	Attenuator	PE7014-10	101692
7.	Antenna	Schwarzbeck UBAA 9114	9111-214
8.	Antenna	HP11966 model 3115	9903-5701
9.	Antenna	VULB9163	9163244
10.	Antenna	ETS-Lindgren 3117	110306
11.	Preamlifier	U3-40	03792
12.	Preamlifier	Agalent 87405C	MY47010400
13.	Preamlifier	BBV 9719	100218
14.	Antenna	BBHA 9170	9170446
15.	Power supply	Б5-29	12426
16.	Psychrometer	ВИТ-2	В931

All listed above test equipment is calibrated and certified in accordance with established procedure. The equipment has certificates currently in force.

Ancillary equipment

№	Name	Model	Serial Number
1.	Servo - mechnism	XT Mini Blue 07 4220	-
2.	Transmitter Module 2.4 Dual FHSS 12-16 channels	Typ-D V4	30120900002

2.5 Measurement uncertainty

Parameter	Maximum uncertainty
Output power	± 1.3 dB
Frequency range	± 1×10^{-5}
Spurious emissions	± 2.7 dB
Radiated Emission	± 4.8 dB
Time	± 3 %
Temperature	± 1°C
Humidity	± 5 %
DC voltage	± 2 %

This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level using a coverage factor of k=2.

Measurement uncertainty complies with the requirements of the normative documents and is guaranteed by the test procedures and test equipment.

2.6 Photo of test site

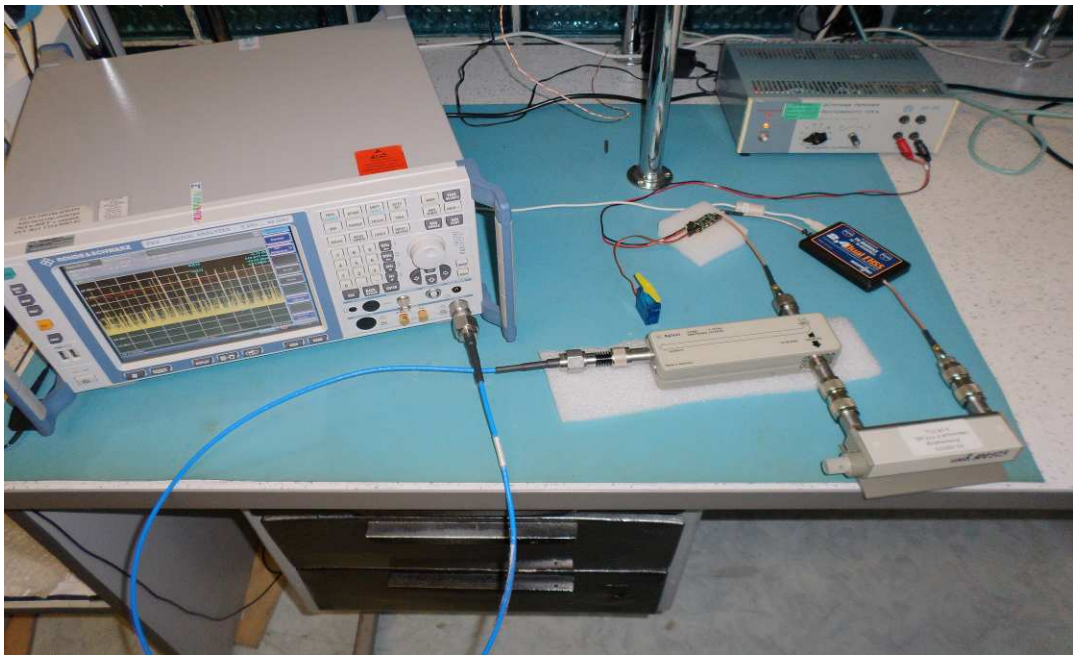


Figure 3 - Conducted Test

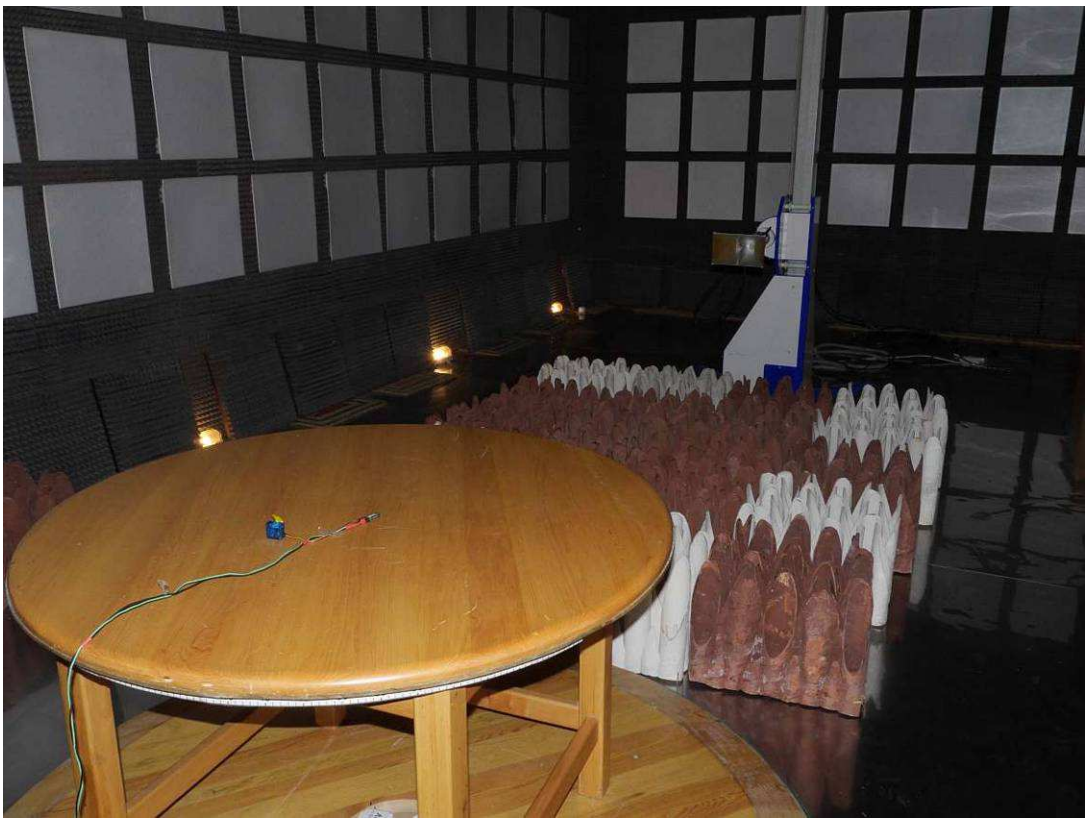


Figure 4 - Radiated Emission Test

Figure 5 - Radiated Emission Test

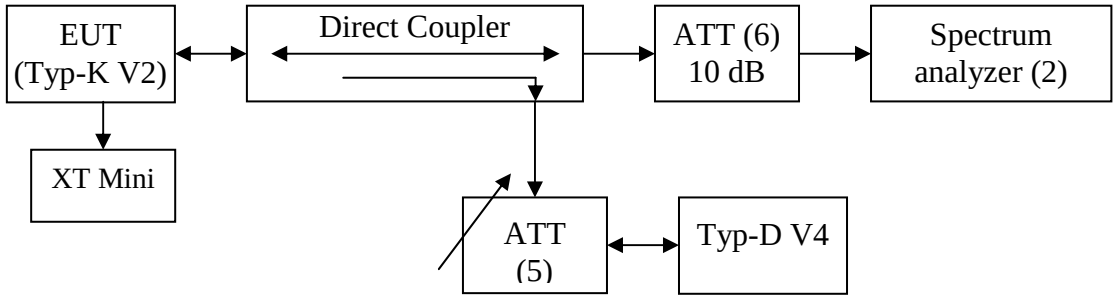
3 REPORT OF MEASUREMENTS AND EXAMINATIONS.

3.1 Hopping channel separation

3.1.1 Test procedure

1) The transmitter output was connected to the spectrum analyzer according to test setup layout (3.1.2).
2) Set RBW of spectrum analyzer to 100 kHz and VBW to 100 kHz.
3) The Hopping channel separation is defined as the channel is separated with the next channel.

3.1.2 Test setup layout



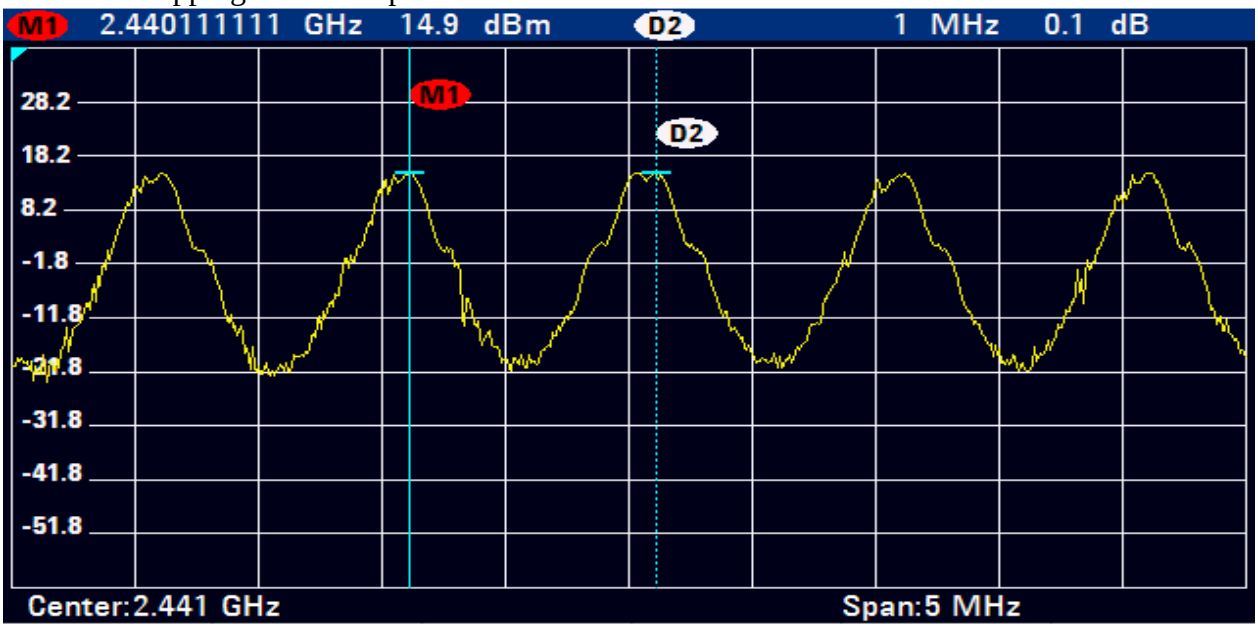
3.1.3 Test result

Temperature: +18 °C Relative humidity: 60 %

Hopping channel separation, MHz	Limit (2/3 of 20dB Bandwidth), kHz	Test Result (Pass, Fail, N/A)
1.0	332	Pass

Remark: frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or **two-thirds** of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

3.1.4 Plot Hopping channel separation

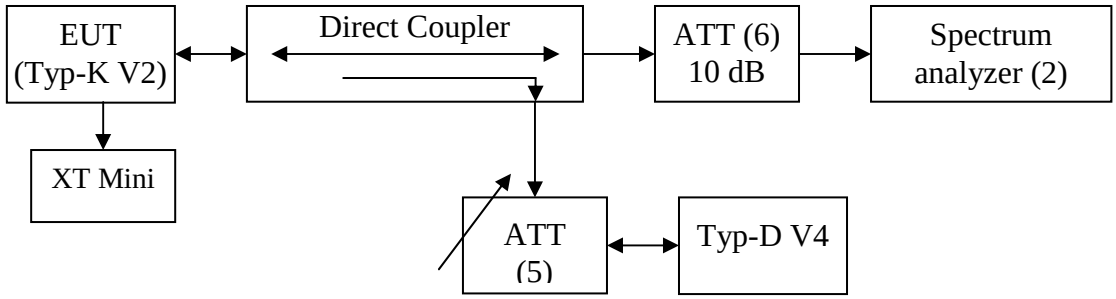


3.2 Number of hopping frequencies used

3.2.1 Test procedure

1) The transmitter output was connected to the spectrum analyzer according to test setup layout (3.2.2).
2) Set RBW of spectrum analyzer to 300 kHz and VBW to 300 kHz.
3) The Number of hopping frequencies used is defined as the device has numbers of total channel.

3.2.2 Test setup layout



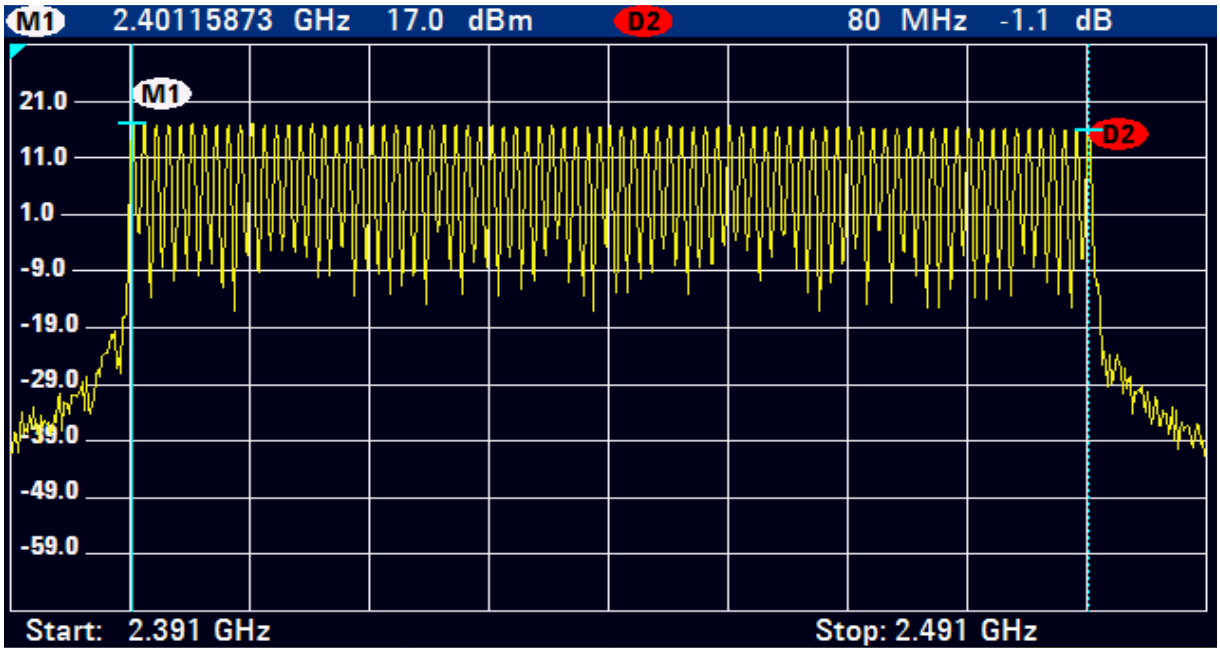
3.2.3 Test result

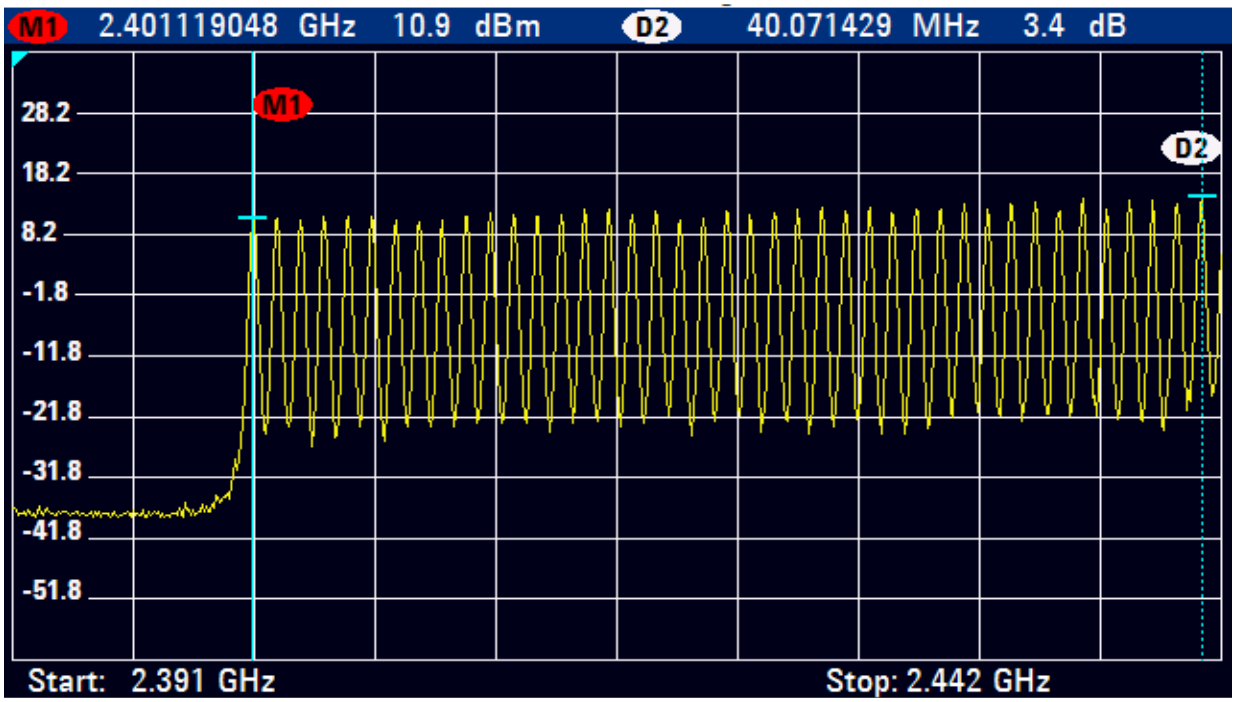
Temperature: +18 °C Relative humidity: 60 %

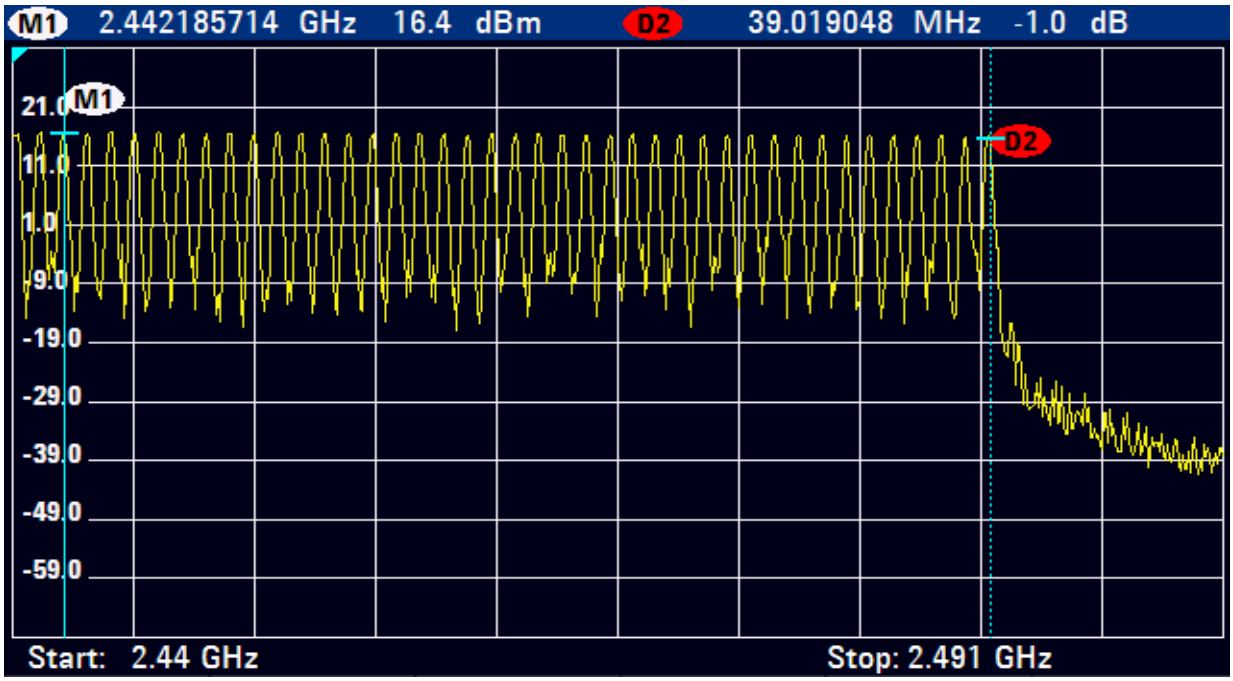
Number of hopping frequencies	Limit	Test Result (Pass, Fail, N/A)
81	15	Pass

Remark: The hopping sequence of a FHSS system is the sequence of the hopping channels used by the equipment. Non-adaptive Frequency Hopping systems shall make use of a hopping sequence(s) that contains at least 15 hopping channels. Adaptive Frequency Hopping systems shall make use of a hopping sequence(s) that is capable of operating over a minimum of 90 % of the band specified in table, from which at any given time a minimum of 20 hopping channels shall be used. Each hopping channel of the hopping sequence shall be occupied at least once during a period not exceeding four times
the product of the dwell time per hop and the number of channels.

3.2.4 Plot Number of hopping frequencies (100 MHZ Span)




M1 2.401119048 GHz 10.9 dBm
D2 40.071429 MHz 3.4 dB
28.2
18.2
8.2
-1.8
-11.8
-21.8
-31.8
-41.8
-51.8
Start: 2.391 GHz
Stop: 2.442 GHz

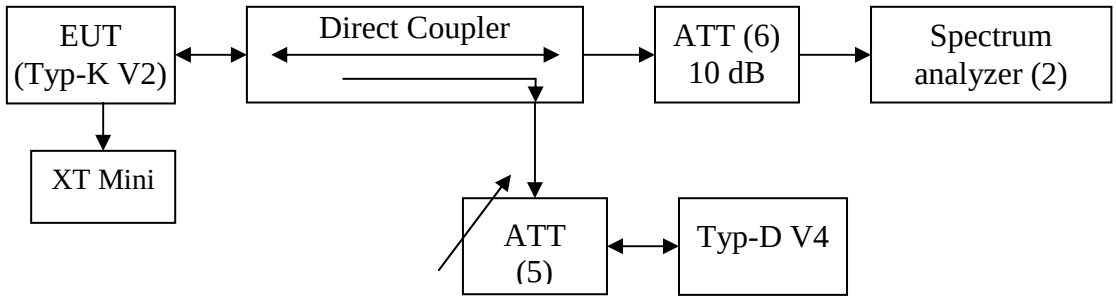

M1 2.442185714 GHz 16.4 dBm
D2 39.019048 MHz -1.0 dB
21.0
11.0
1.0
-9.0
-19.0
-29.0
-39.0
-49.0
-59.0
Start: 2.44 GHz
Stop: 2.491 GHz

3.3 Hopping channel bandwidth

3.3.1 Test procedure

1) The transmitter output was connected to the spectrum analyzer according to test setup layout (3.3.2).
2) Set RBW of spectrum analyzer to 100 kHz and VBW to 100 kHz.
3) The Hopping channel bandwidth is defined as the frequency range where the power is higher than peak power minus 20 dB.

3.3.2 Test setup layout



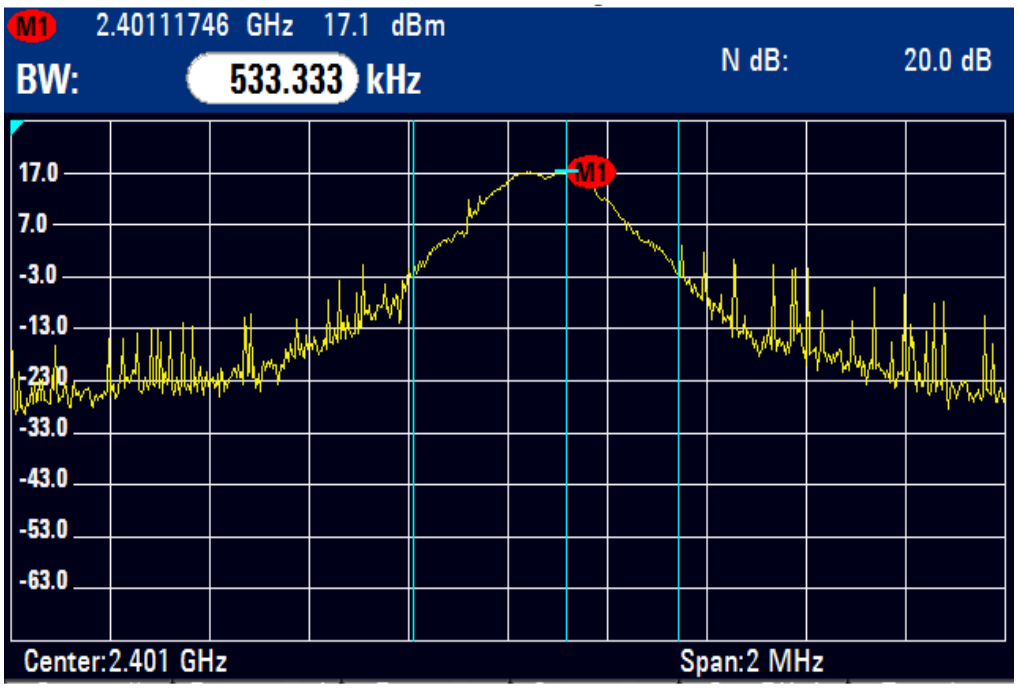
3.3.3 Test result

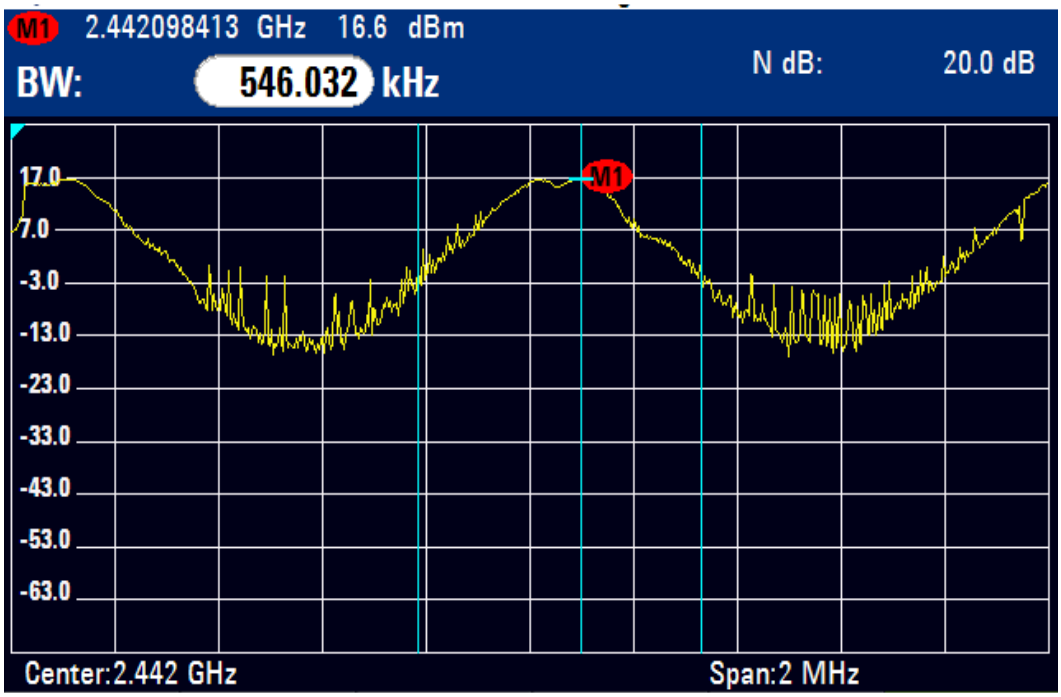
Temperature: +18 °C Relative humidity: 60%

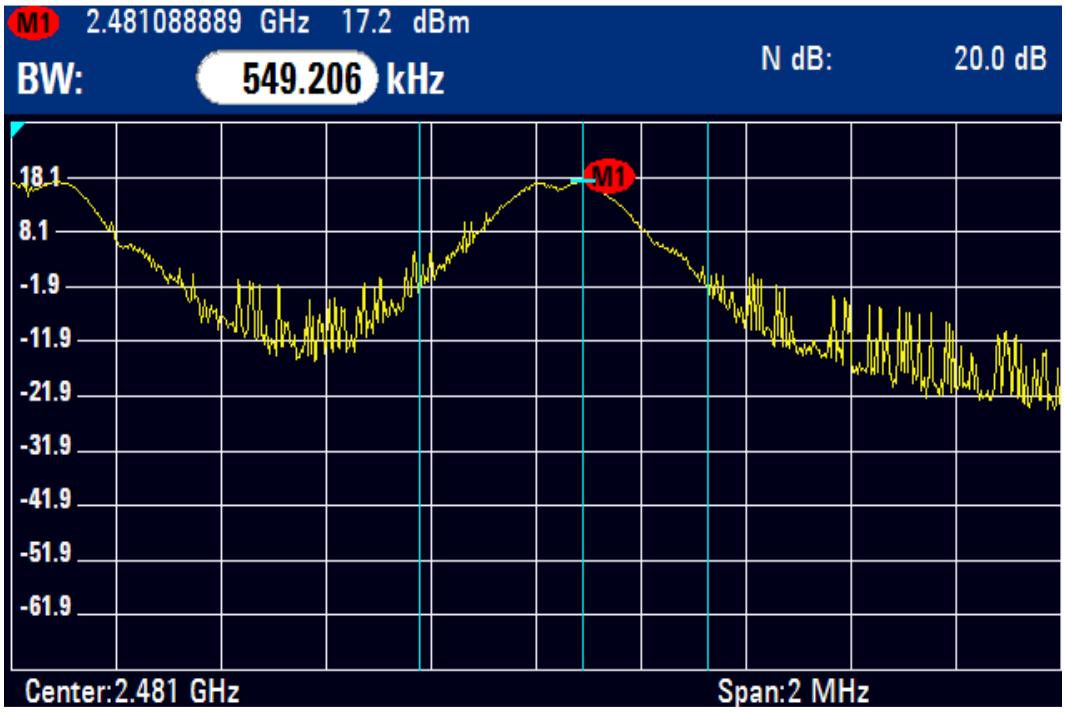
Channel	Frequency, MHz	Hopping channel bandwidth, MHz	Limit, MHz	Test Result (Pass, Fail, N/A)
0	2401	0.533	1.0	Pass
41	2442	0.546	1.0	Pass
80	2481	0.549	1.0	Pass

Remark: Non-adaptive Frequency Hopping systems shall make use of non-overlapping hopping channels separated by the channel bandwidth as measured at 20 dB below peak power.
The hopping channels defined within a hopping sequence shall be at least 1 MHz apart (channel separation).

3.3.4 Plot Channel bandwidth




M1 2.442098413 GHz 16.6 dBm
BW: 546.032 kHz
N dB: 20.0 dB
17.0
7.0
-3.0
-13.0
-23.0
-33.0
-43.0
-53.0
-63.0
M1
Center:2.442 GHz
Span:2 MHz

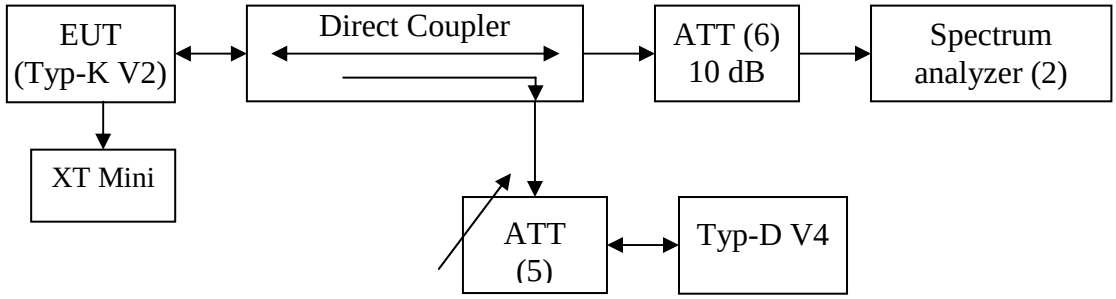

M1 2.481088889 GHz 17.2 dBm
BW: 549.206 kHz
N dB: 20.0 dB
18.1
8.1
-1.9
-11.9
-21.9
-31.9
-41.9
-51.9
-61.9
M1
Center:2.481 GHz
Span:2 MHz

3.4 Dwell Time of Each Frequency

3.4.1 Test procedure

1) The transmitter output was connected to the spectrum analyzer according to test setup layout (3.4.2).
2) Set RBW of spectrum analyzer to 300 KHz and VBW to 1 MHz.
3) Set the center frequency on any frequency would be measured and set the frequency span to zero span.

3.4.2 Test setup layout



3.4.3 Test result

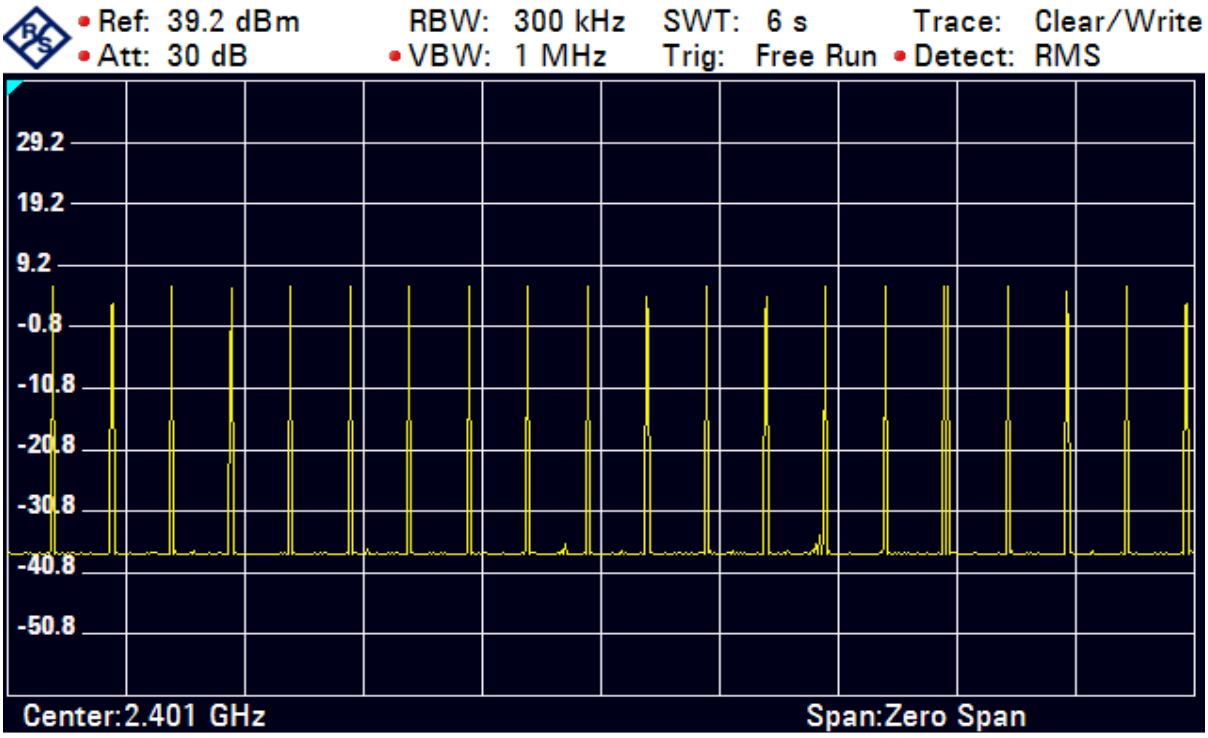
Temperature: +18 °C Relative humidity: 60 %

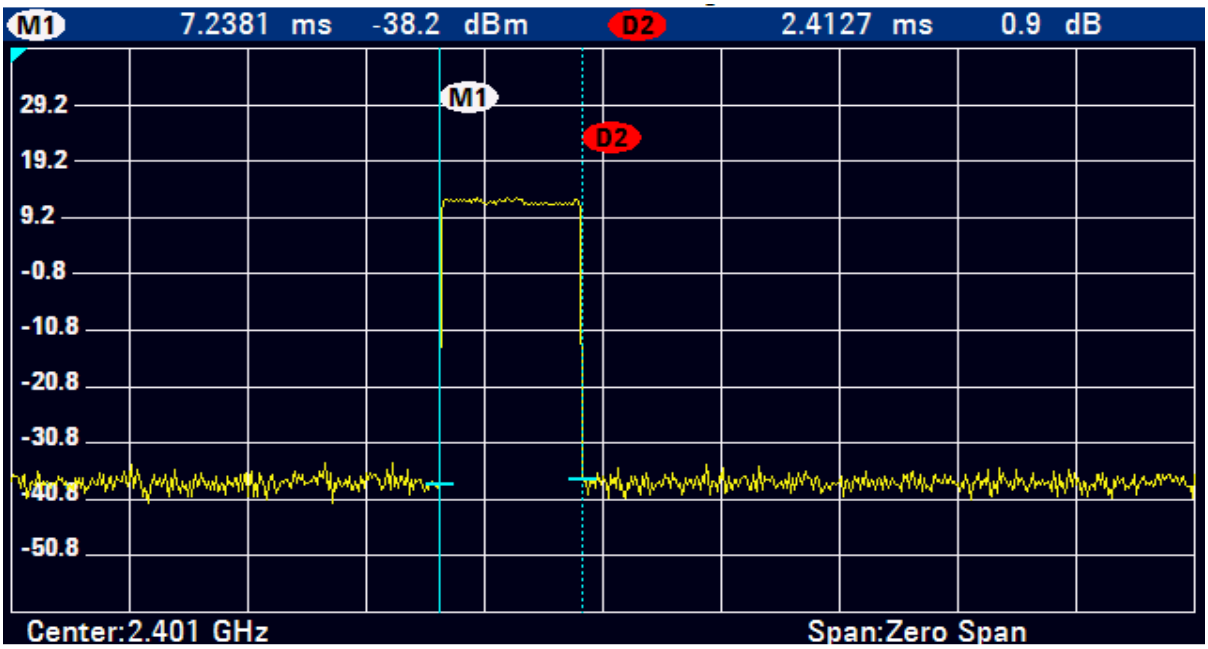
Channels	Pulse width (ms)	Number of 6 sec	Dwell Time, ms	Limit, s	Test Result (Pass, Fail, N/A)
0	2.4127	20	48.254	0.4	Pass
80	2.4762	10	24.762	0.4	Pass

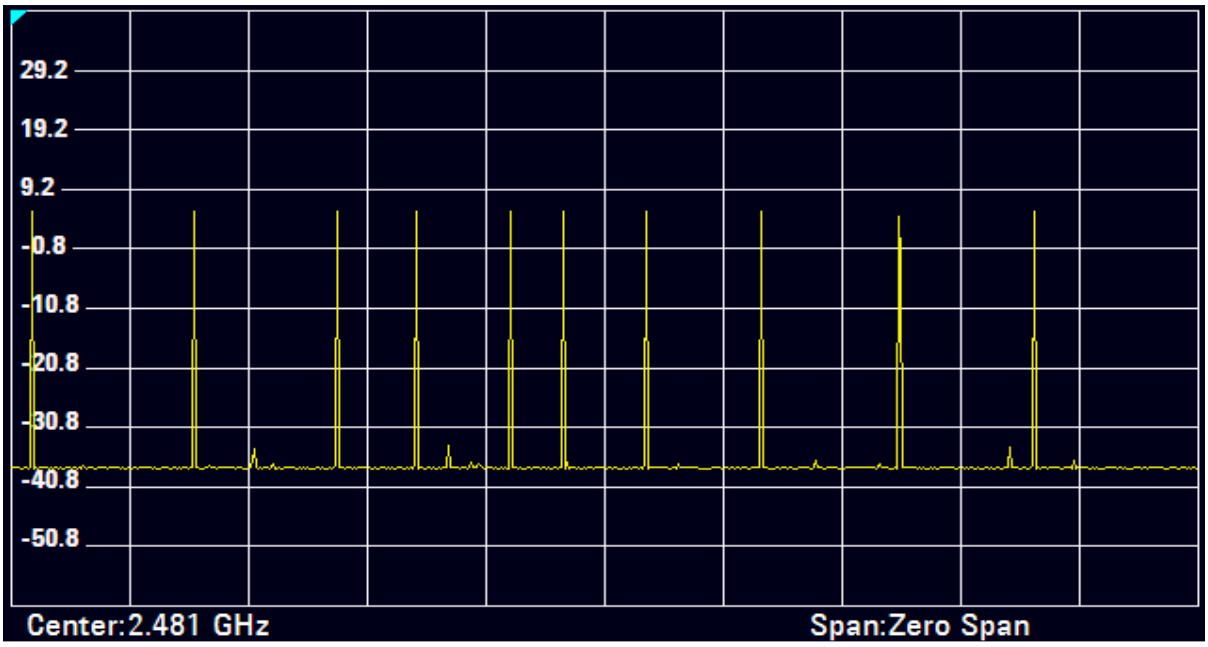
Remark:

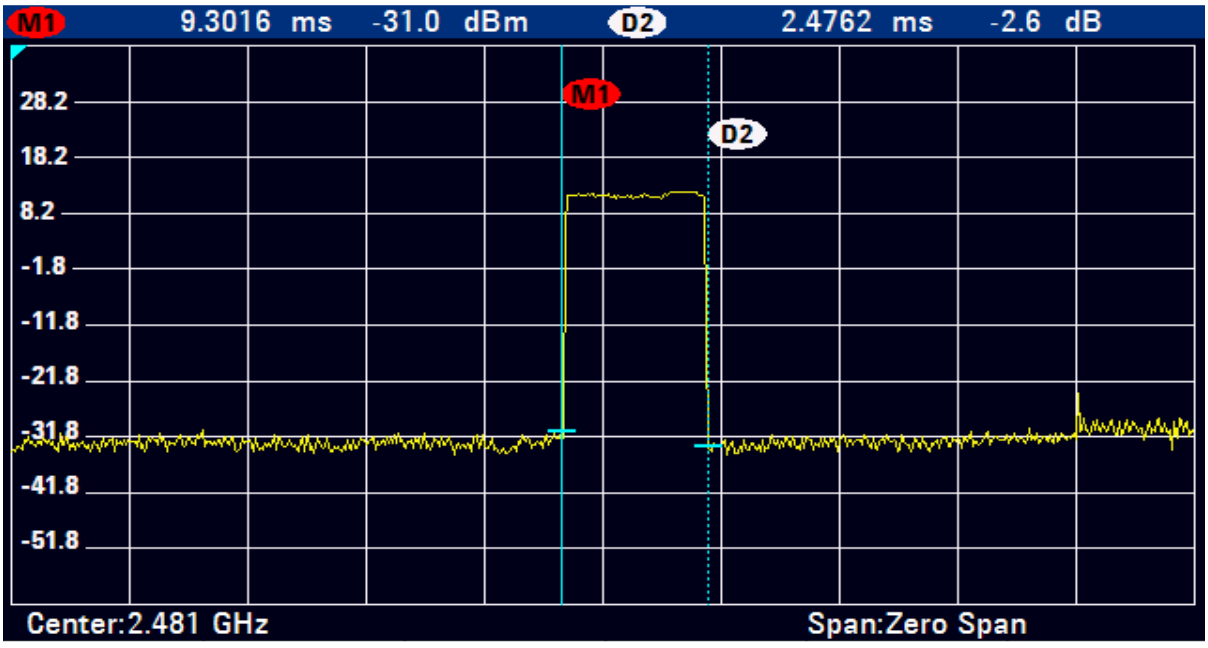
1. Dwell time = pulse width * Number of 6 sec.
2. 6 sec = 0.4 sec *15 times (Dwell Time * Minimum number of hopping frequencies)

3.4.4 Plots Dwell Time




M1 7.2381 ms -38.2 dBm
D2 2.4127 ms 0.9 dB
29.2
19.2
9.2
-0.8
-10.8
-20.8
-30.8
-40.8
-50.8
Center:2.401 GHz
Span:Zero Span


29.2
19.2
9.2
-0.8
-10.8
-20.8
-30.8
-40.8
-50.8
Center:2.481 GHz
Span:Zero Span

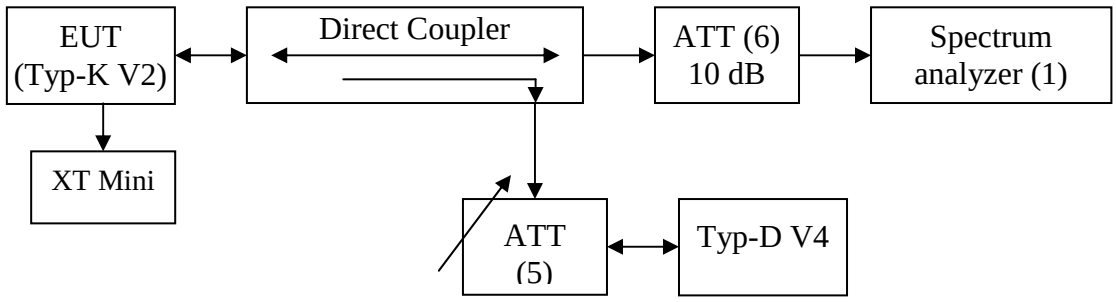

M1 9.3016 ms -31.0 dBm
D2 2.4762 ms -2.6 dB
28.2
18.2
8.2
-1.8
-11.8
-21.8
-31.8
-41.8
-51.8
Center:2.481 GHz
Span:Zero Span

3.5 Output power

3.5.1 Test procedure

1) The transmitter output was connected to the spectrum analyzer according to test setup layout (3.5.2).
2) The center frequency of the spectrum analyzer was set to the fundamental frequency and set RBW to 1 MHz and VBW to 1 MHz.

3.5.2 Test setup layout



3.5.3 Test result

Temperature: +18 °C Relative humidity: 60 %

Channel	Frequency, MHz	Measured output power, W	Limit, W	Test Result (Pass, Fail, N/A)
0	2401	0.0302	1.0	Pass
41	2442	0.0260	1.0	Pass
80	2481	0.0245	1.0	Pass

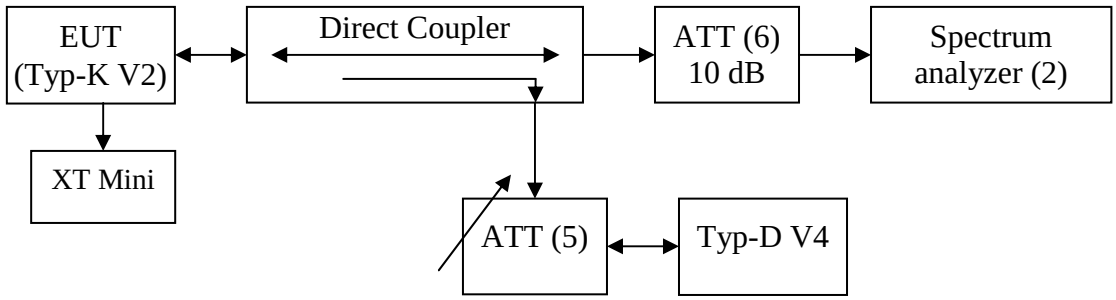
Remark: For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2401-2483.5 MHz band: 0.125 watts.
So the Limit is 1 watt.

3.6 100 kHz Bandwidth of Frequency Band Edges measurement

3.6.1 Test procedure

The EUT output was connected to the spectrum analyzer according to test setup layout (3.6.2). Set both RBW and VBW of spectrum analyzer to 100 kHz with suitable frequency span including 100MHz bandwidth from band edge. The band edges was measured and recorded. The spectrum plots (Peak RBW=VBW=100 kHz) are attached on the following pages.

3.6.2 Test setup layout



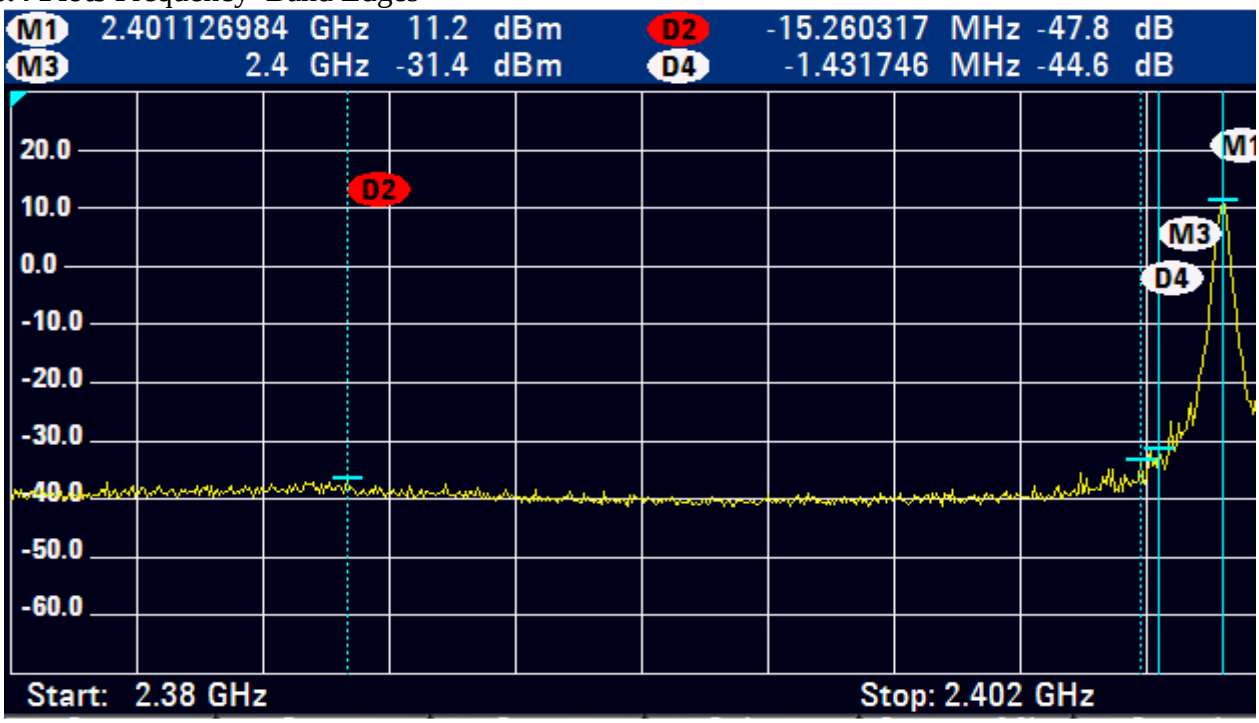
3.6.3 Test result

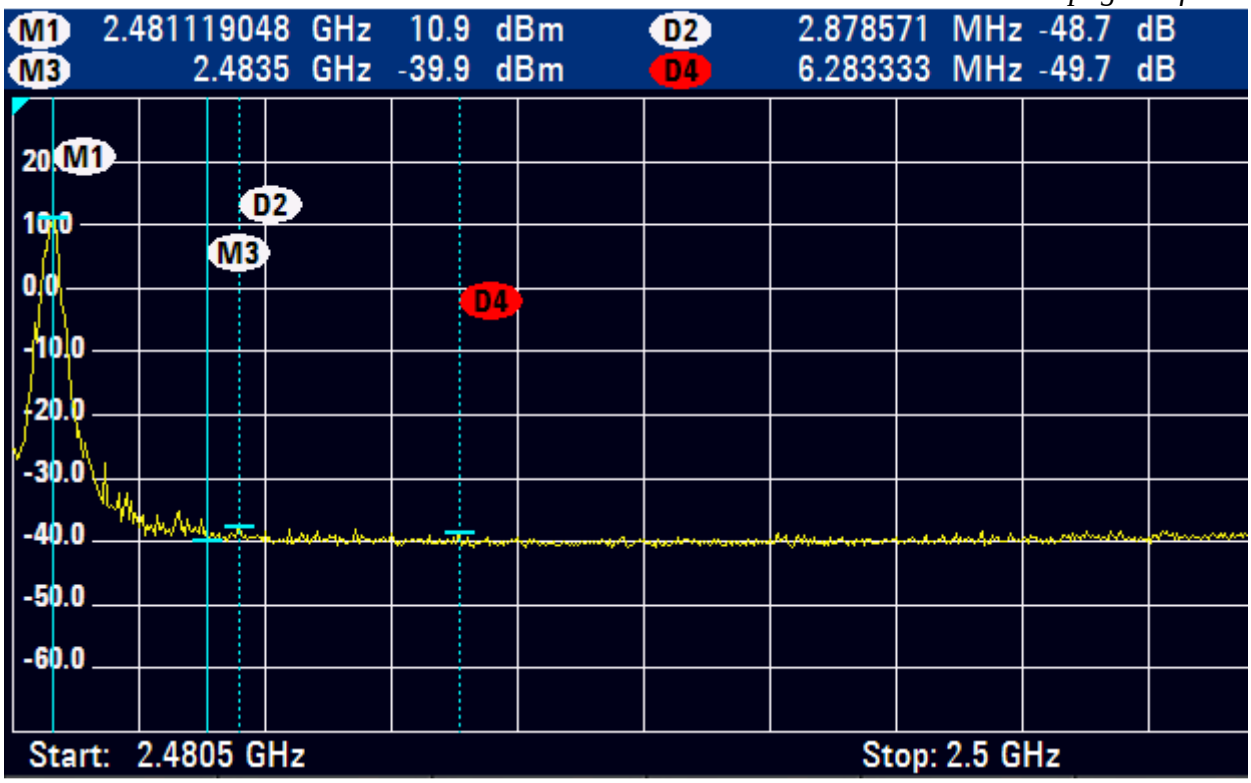
Temperature: +18°C Relative humidity: 60

Frequency, MHz	Measured, dBm	Limit, dBm	Test Result (Pass, Fail, N/A)
2385.87	- 47.8	- 20	Pass
2399.69	- 44.6	- 20	Pass
2484.00	- 48.7	- 20	Pass
2487.41	- 49.7	- 20	Pass

Remark:
Below –20dB of the highest emission level of operating band (in 100 kHz Resolution Bandwidth)

3.6.4 Plots Frequency Band Edges




M1 2.481119048 GHz 10.9 dBm
M3 2.4835 GHz -39.9 dBm
D2 2.878571 MHz -48.7 dB
D4 6.283333 MHz -49.7 dB
20
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
Start: 2.4805 GHz
Stop: 2.5 GHz

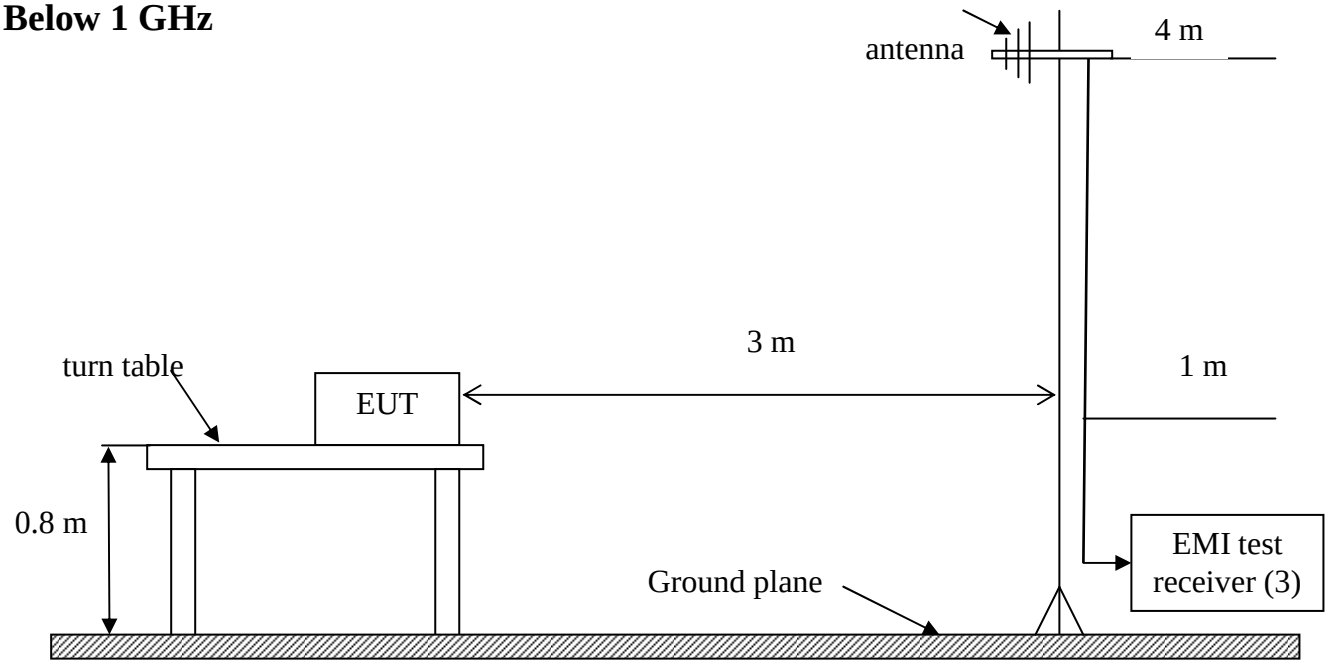
3.7 Radiated Emission from Transmitter Part

3.7.1 Test procedure

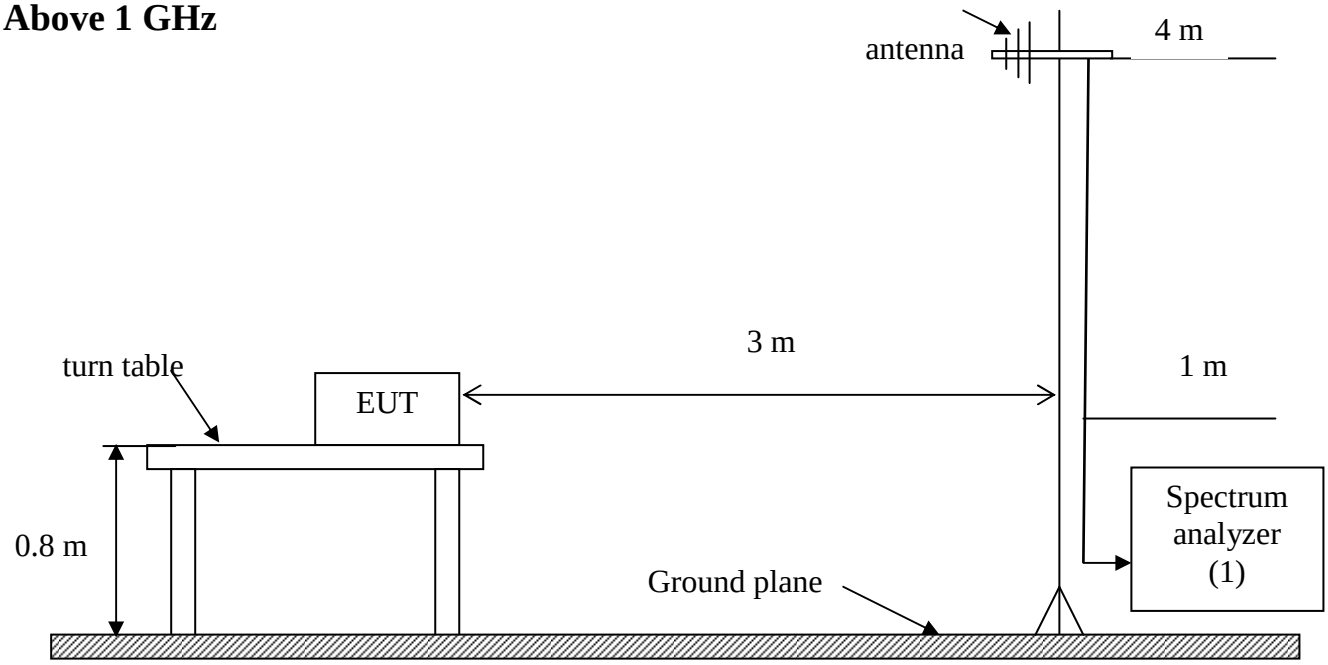
1) The EUT was placed on a rotatable table top 0.8 m above the floor.
2) The EUT was set 3 meters from the interference receiving antenna which was mounted on the top of a variable height antenna tower.
3) The table was rotated 360 degrees to determine the position of the highest radiation.
4) The antenna is a broadband antenna and its height is varied between 1 meter and 4 meters above the floor to find the maximum value of the shield strength for both horizontal polarization and vertical polarization of the antenna.
5) For each suspected emission, the EUT was arranged to its worst case.
6) On any frequency or frequencies below or equal to 1000 MHz the test-receiver was set to Quasi-peak detector function with specified bandwidth with maximum hold mode.
7) On any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function and peak detector function. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to EUT. Measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz.

3.7.2 Test setup layout

Below 1 GHz



Above 1 GHz



Limit

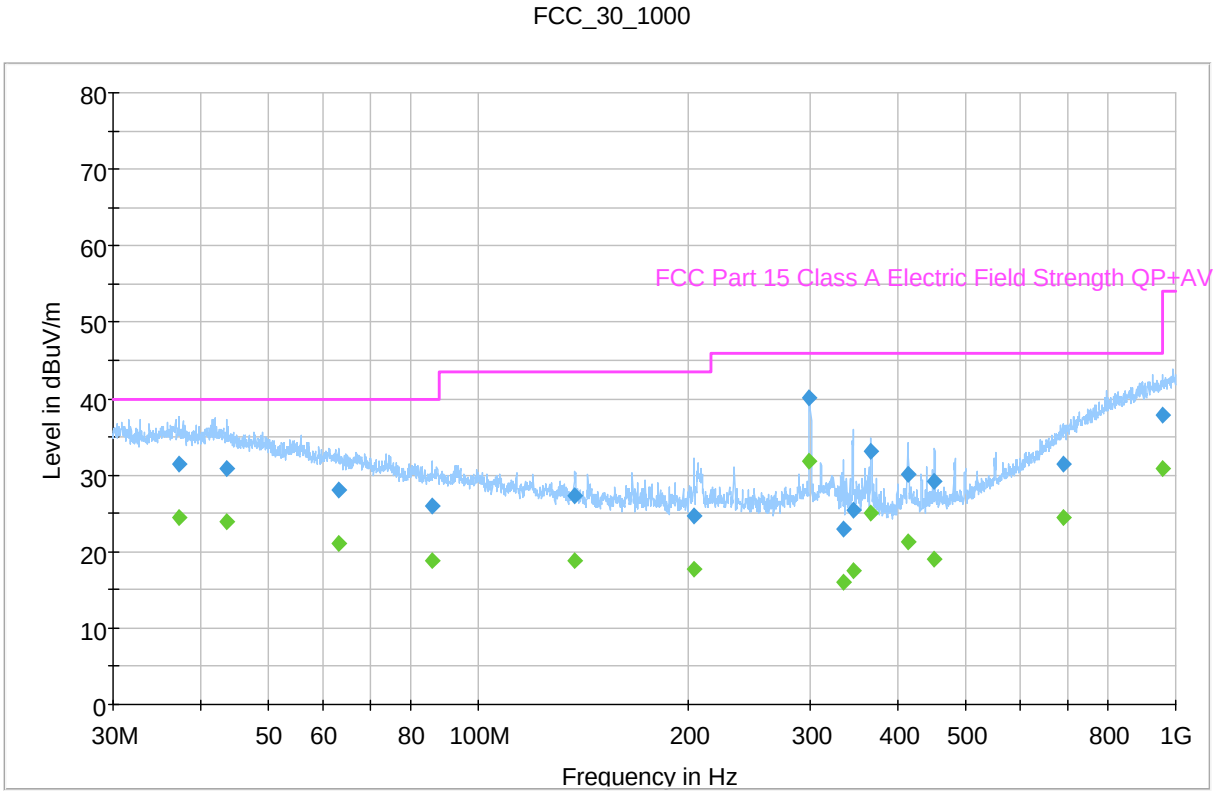
Frequency (MHz)	**Field Strength (dBuV/m at 3-meter)**
30-88	40
88-216	43.5
216-960	46
Above 960	54

3.7.3 Test result radiated emission from transmitter part

Temperature: +18 °C Relative humidity: 60 %

Mode Transmitter on

Below 1 GHz



Final Result 1

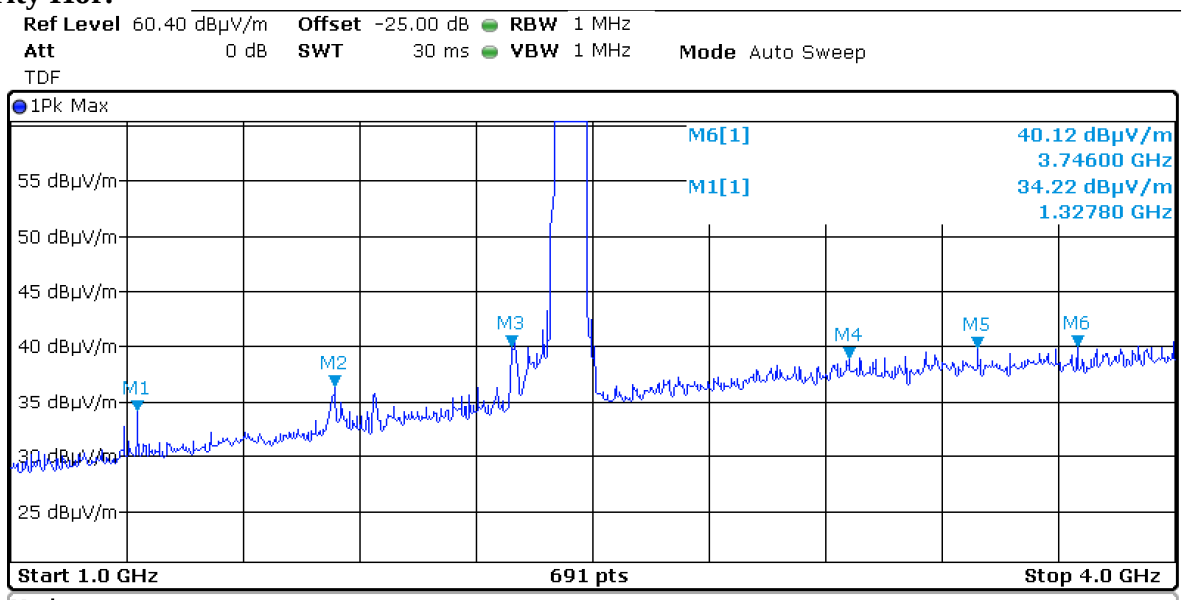
Frequency (MHz)	QuasiPeak (dBuV/m)	Height (cm)	Polarization	Corr. (dB)	Margin (dB)	Limit (dBuV/m)
37.303548	31.4	200.0	H	35.9	8.6	40.0
43.597966	31.0	200.0	H	35.2	9.0	40.0
63.296126	28.0	300.0	H	32.3	12.0	40.0
85.941878	25.9	300.0	H	29.9	14.1	40.0
137.47421	27.2	100.0	V	26.8	16.3	43.5
203.82046	24.6	100.0	V	25.9	18.9	43.5
298.88179	40.0	100.0	V	24.3	6.0	46.0
334.28441	23.0	400.0	H	24.1	23.0	46.0
345.49414	25.5	100.0	V	24.0	20.5	46.0
365.38358	33.2	300.0	H	23.9	12.8	46.0
412.76843	30.1	100.0	V	24.1	15.9	46.0
451.62030	29.2	100.0	V	25.2	16.8	46.0
689.26818	31.4	200.0	V	34.7	14.6	46.0
957.63436	37.8	300.0	H	40.8	8.2	46.0

Final Result 2

Frequency (MHz)	Average (dBuV/m)	Height (cm)	Polarization	Corr. (dB)	Margin (dB)	Limit (dBuV/m)
37.303548	24.4	200.0	H	35.9	15.6	40.0
43.597966	23.9	200.0	H	35.2	16.1	40.0
63.296126	21.0	300.0	H	32.3	19.0	40.0
85.941878	18.9	300.0	H	29.9	21.1	40.0
137.47421	18.9	100.0	V	26.8	24.6	43.5
203.82046	17.6	100.0	V	25.9	25.9	43.5
298.88179	31.8	100.0	V	24.3	14.2	46.0
334.28441	15.9	400.0	H	24.1	30.1	46.0
345.49414	17.5	100.0	V	24.0	28.5	46.0
365.38358	25.0	300.0	H	23.9	21.0	46.0
412.76843	21.2	100.0	V	24.1	24.8	46.0
451.62030	18.9	100.0	V	25.2	27.1	46.0
689.26818	24.4	200.0	V	34.7	21.6	46.0
957.63436	30.9	300.0	H	40.8	15.1	46.0

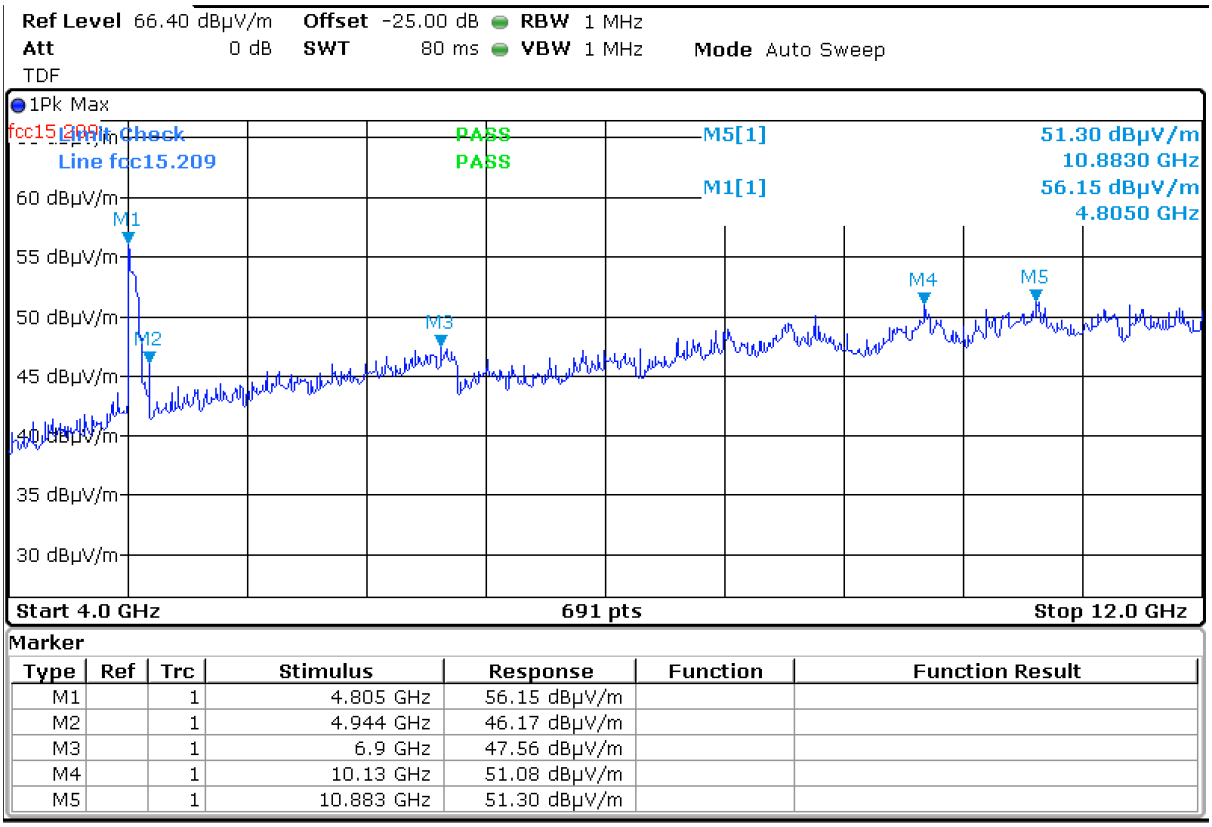
Above 1 GHz

Polarity Hor.



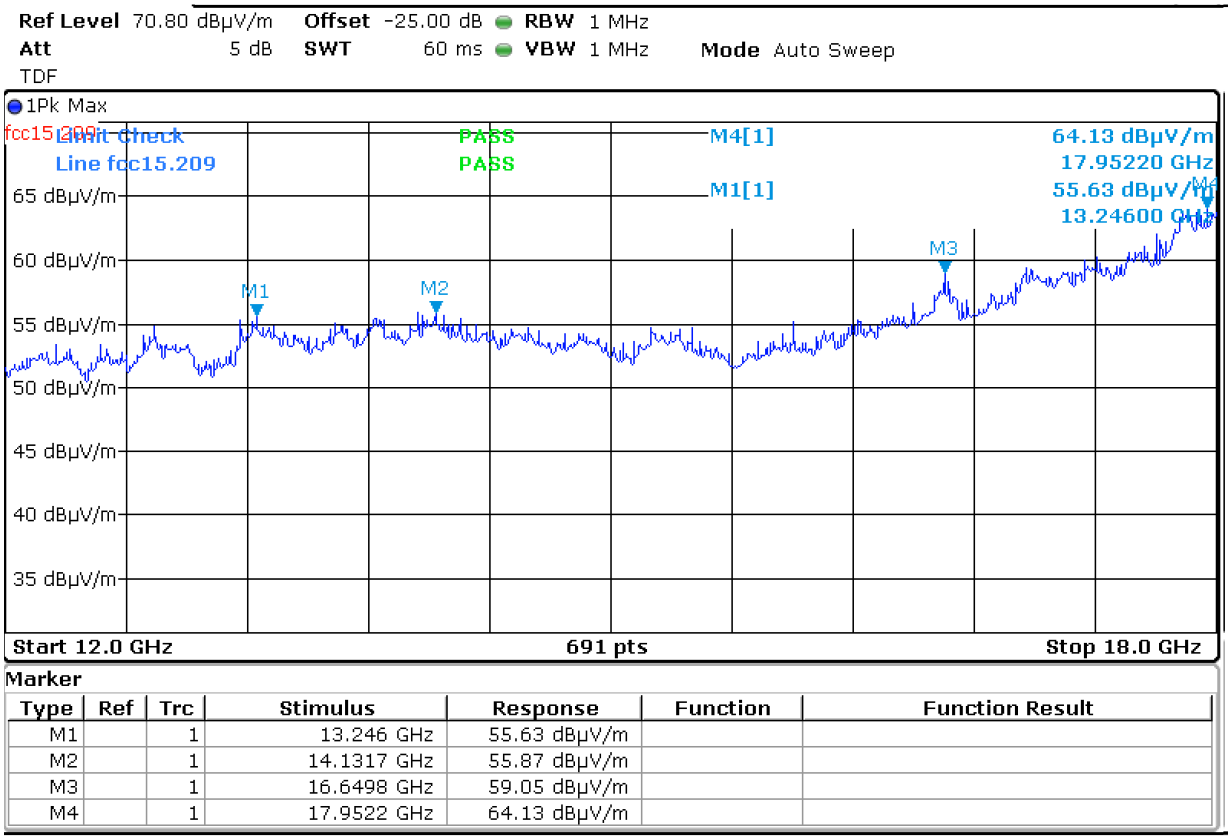
Marker

Type	Ref	Trc	Stimulus	Response	Function	Function Result
M1		1	1.3278 GHz	34.22 dBµV/m		
M2		1	1.8357 GHz	36.39 dBµV/m		
M3		1	2.2916 GHz	40.04 dBµV/m		
M4		1	3.1599 GHz	38.99 dBµV/m		
M5		1	3.4899 GHz	39.96 dBµV/m		
M6		1	3.746 GHz	40.12 dBµV/m		



Marker

Type	Ref	Trc	Stimulus	Response	Function	Function Result
M1		1	4.805 GHz	56.15 dBµV/m		
M2		1	4.944 GHz	46.17 dBµV/m		
M3		1	6.9 GHz	47.56 dBµV/m		
M4		1	10.13 GHz	51.08 dBµV/m		
M5		1	10.883 GHz	51.30 dBµV/m		



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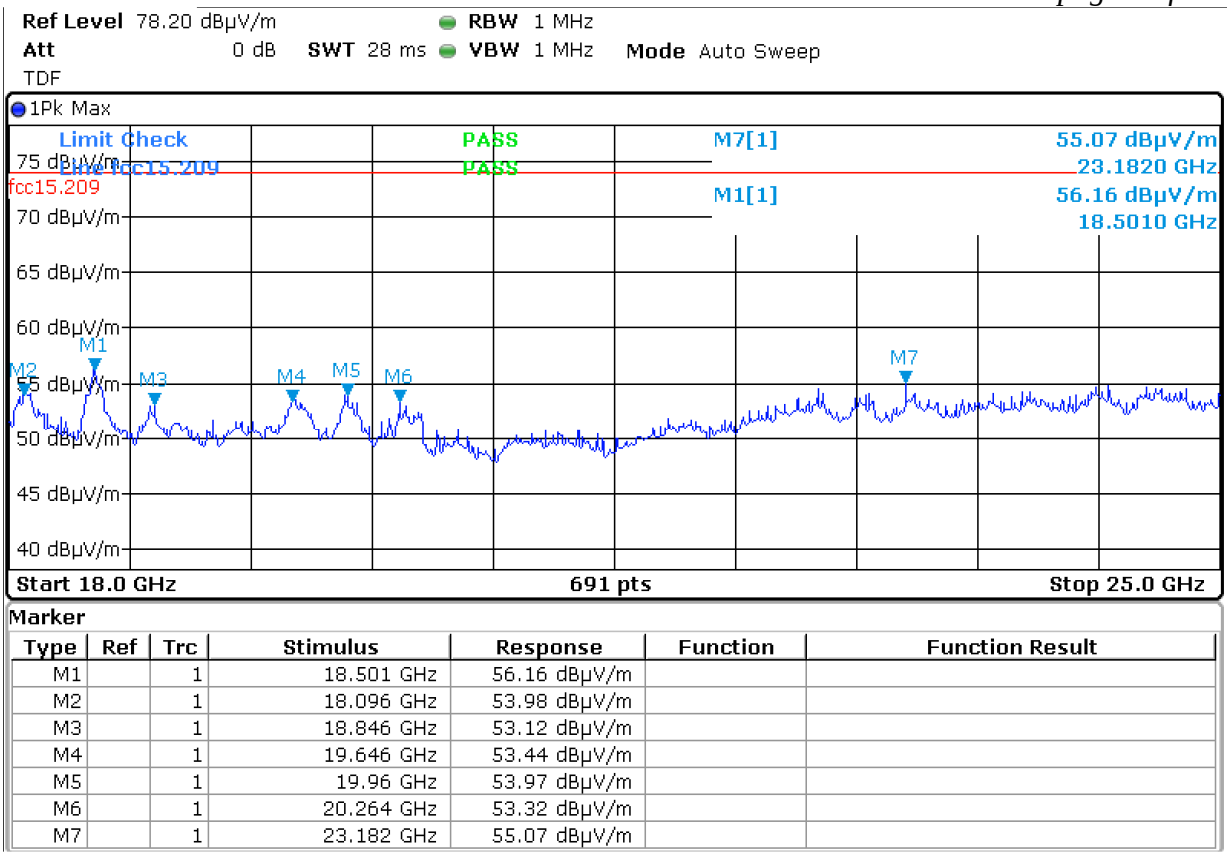
Type	Ref	Trc	Stimulus	Response	Function	Function Result
M1		1	13.246 GHz	55.63 dBµV/m		
M2		1	14.1317 GHz	55.87 dBµV/m		
M3		1	16.6498 GHz	59.05 dBµV/m		
M4		1	17.9522 GHz	64.13 dBµV/m		



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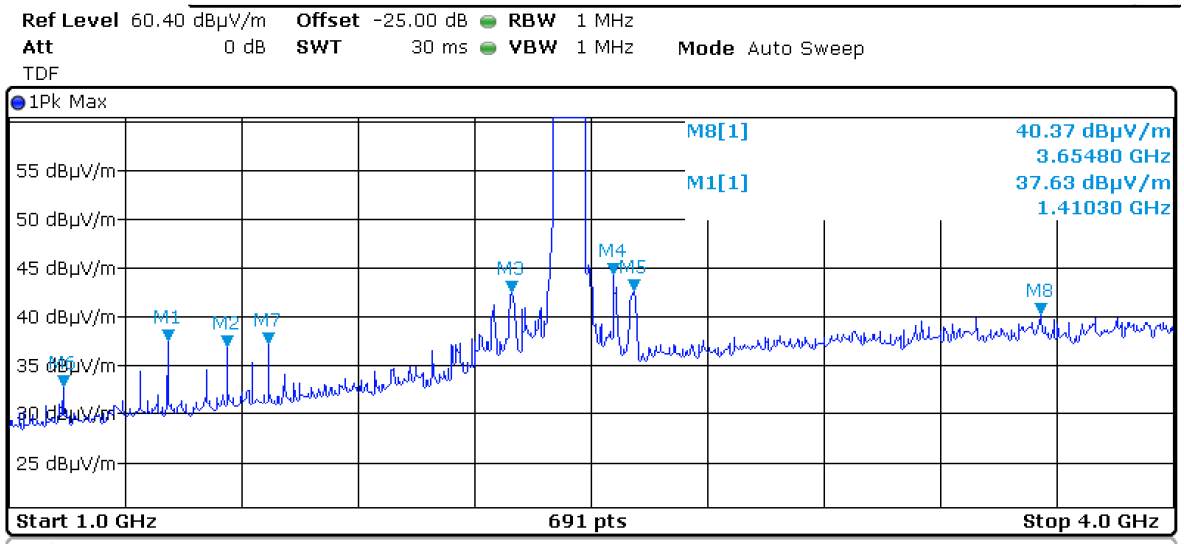
Type	Ref	Trc	Stimulus	Response	Function	Function Result
M1		1	18.501 GHz	56.16 dBµV/m		
M2		1	18.096 GHz	53.98 dBµV/m		
M3		1	18.846 GHz	53.12 dBµV/m		
M4		1	19.646 GHz	53.44 dBµV/m		
M5		1	19.96 GHz	53.97 dBµV/m		
M6		1	20.264 GHz	53.32 dBµV/m		
M7		1	23.182 GHz	55.07 dBµV/m		

Final Result 3

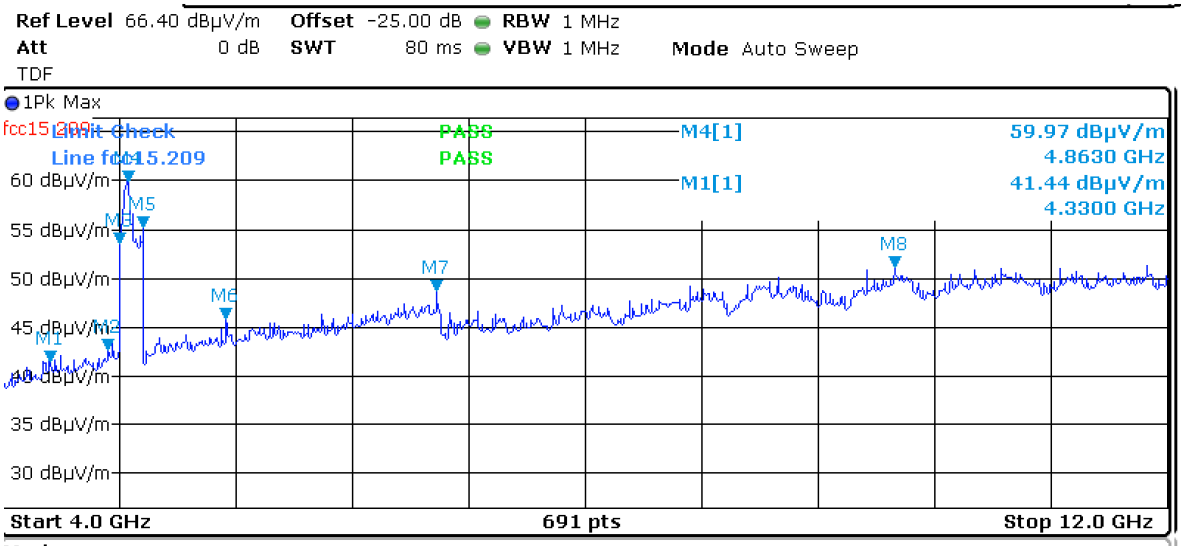
Frequency (MHz)	Antenna factor, dB	Value Average (dBuV/m)	Value Peak (dBuV/m)	Limit peak (dBuV/m)	Limit average (dBuV/m)
1327.8	24.8	24.12	34.22	74	54
1835.7	27.6	26.11	36.39	74	54
2291.6	28.2	29.73	40.04	74	54
3159.9	31.2	29.44	38.99	74	54
3489.9	32.6	30.22	39.96	74	54
3746.0	32.4	30.42	40.12	74	54
4805.0	32.2	45.77	56.15	74	54
4944.0	32.0	35.45	46.17	74	54
6900.0	36.0	35.90	47.56	74	54
10130.0	38.2	41.17	51.08	74	54
10833.0	38.8	41.34	51.30	74	54
18096.0	37.9	44.43	53.98	74	54
18501.0	37.9	46.05	56.16	74	54
19960.0	38.0	44.14	53.97	74	54
20264.0	38.0	43.88	53.32	74	54
23183.0	39.9	44.68	55.07	74	54

Polarity Ver.



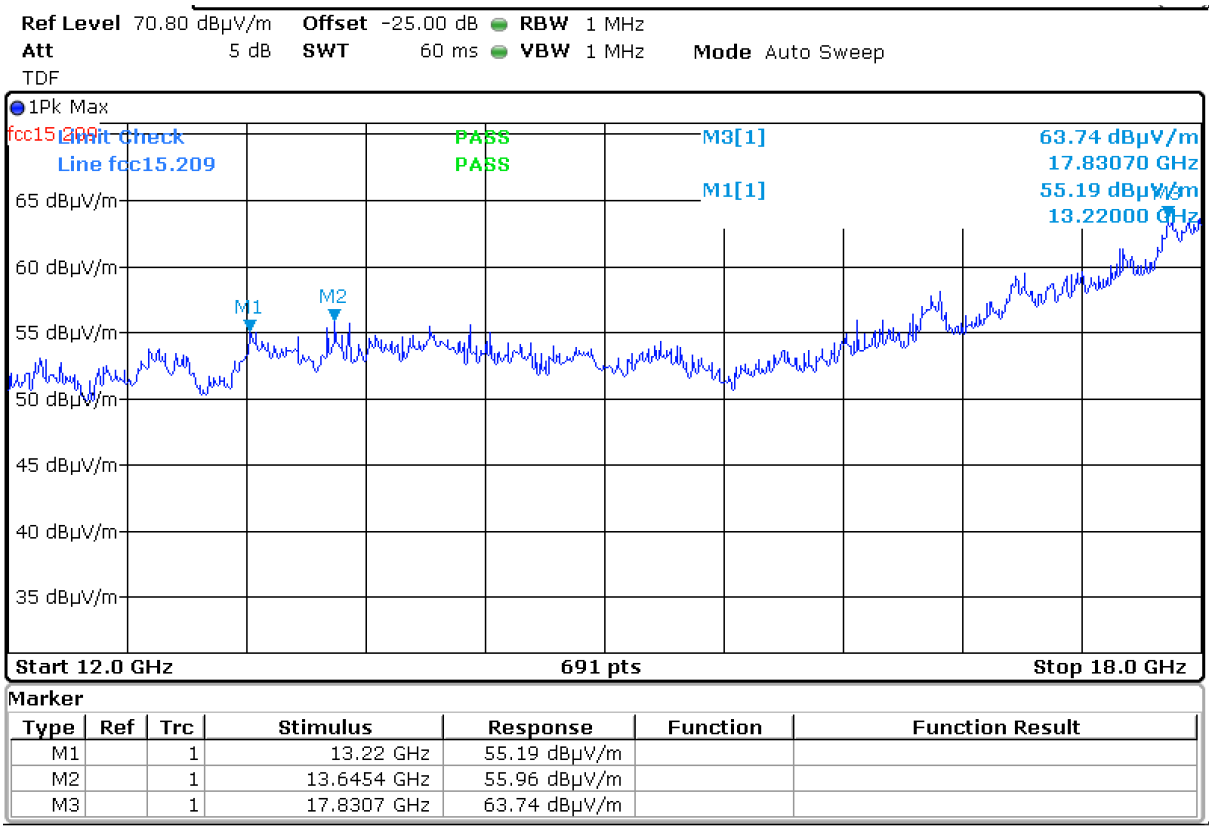
Marker

Type	Ref	Trc	Stimulus	Response	Function	Function Result
M1		1	1.4103 GHz	37.63 dBµV/m		
M2		1	1.5622 GHz	36.97 dBµV/m		
M3		1	2.2959 GHz	42.62 dBµV/m		
M4		1	2.5564 GHz	44.42 dBµV/m		
M5		1	2.6085 GHz	42.67 dBµV/m		
M6		1	1.1411 GHz	33.00 dBµV/m		
M7		1	1.6708 GHz	37.35 dBµV/m		
M8		1	3.6548 GHz	40.37 dBµV/m		



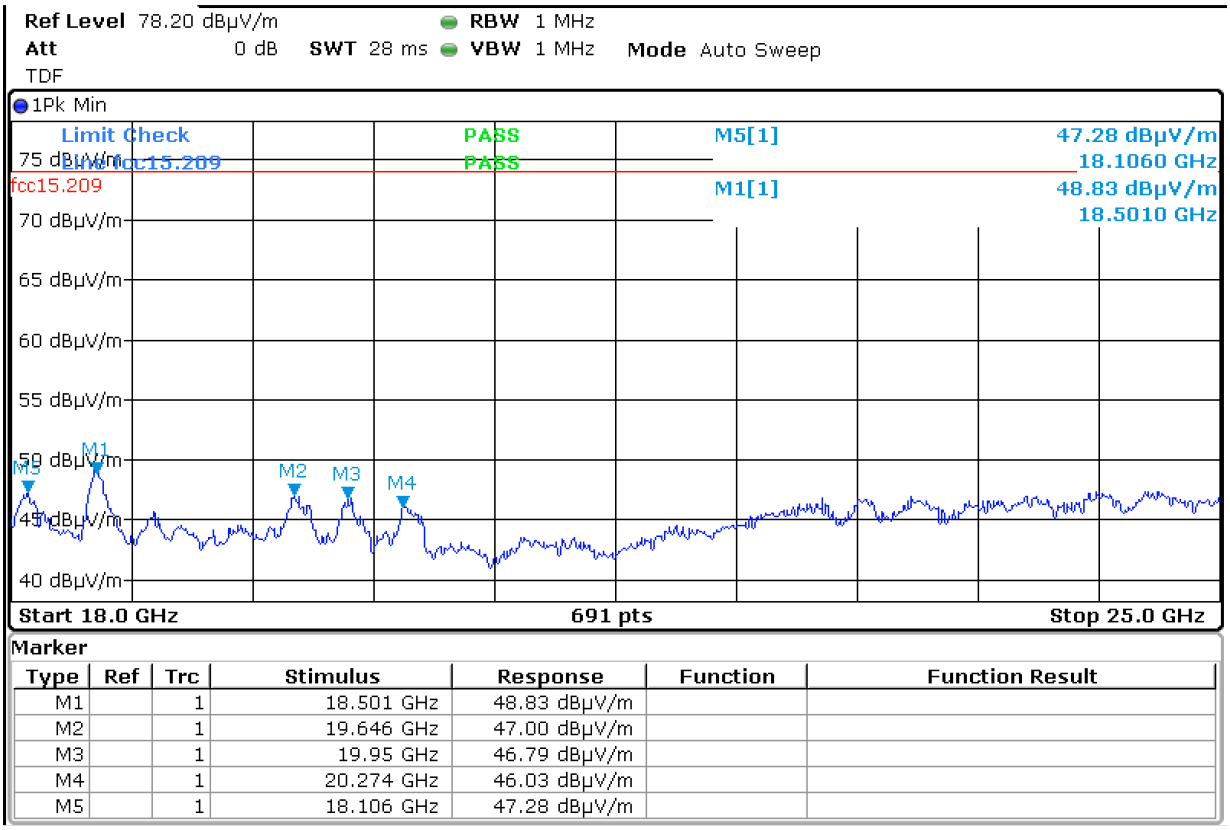
Marker

Type	Ref	Trc	Stimulus	Response	Function	Function Result
M1		1	4.33 GHz	41.44 dBµV/m		
M2		1	4.724 GHz	42.69 dBµV/m		
M3		1	4.805 GHz	53.61 dBµV/m		
M4		1	4.863 GHz	59.97 dBµV/m		
M5		1	4.967 GHz	55.16 dBµV/m		
M6		1	5.534 GHz	45.92 dBµV/m		
M7		1	6.981 GHz	48.67 dBµV/m		
M8		1	10.119 GHz	51.15 dBµV/m		



Marker

Type	Ref	Trc	Stimulus	Response	Function	Function Result
M1		1	13.22 GHz	55.19 dBµV/m		
M2		1	13.6454 GHz	55.96 dBµV/m		
M3		1	17.8307 GHz	63.74 dBµV/m		



Marker

Type	Ref	Trc	Stimulus	Response	Function	Function Result
M1		1	18.501 GHz	48.83 dBµV/m		
M2		1	19.646 GHz	47.00 dBµV/m		
M3		1	19.95 GHz	46.79 dBµV/m		
M4		1	20.274 GHz	46.03 dBµV/m		
M5		1	18.106 GHz	47.28 dBµV/m		

Final Result 4

Frequency (MHz)	Antenna factor, dB	Value Average (dBuV/m)	Value Peak (dBuV/m)	Limit peak (dBuV/m)	Limit average (dBuV/m)
1410.3	24.8	26.90	37.63	74	54
1562.2	24.9	26.66	36.97	74	54
2295.9	28.2	32.15	42.62	74	54
2556.4	28.8	32.40	42.42	74	54
3654.8	32.6	28.88	40.37	74	54
4330.0	32.4	29.99	41.44	74	54
4724.0	39.9	31.57	42.69	74	54
4863.0	41.1	50.11	59.97	74	54
5534.0	34.7	35.65	45.92	74	54
6981.0	36.0	37.93	48.67	74	54
10119.0	38.2	40.65	51.15	74	54
13220.0	39.9	44.16	55.19	74	54
13645.4	40.9	44.57	55.96	74	54
17830.7	47.4	52.88	63.74	74	54
18106.0	37.9	37.23	47.28	74	54
18501.0	37.9	38.67	48.83	74	54
19646.0	38.0	36.54	47.00	74	54
19950.0	38.0	35.87	46.79	74	54
20274.0	38.0	35.78	46.03	74	54

3.8 Radiated Emission from Receiver Part

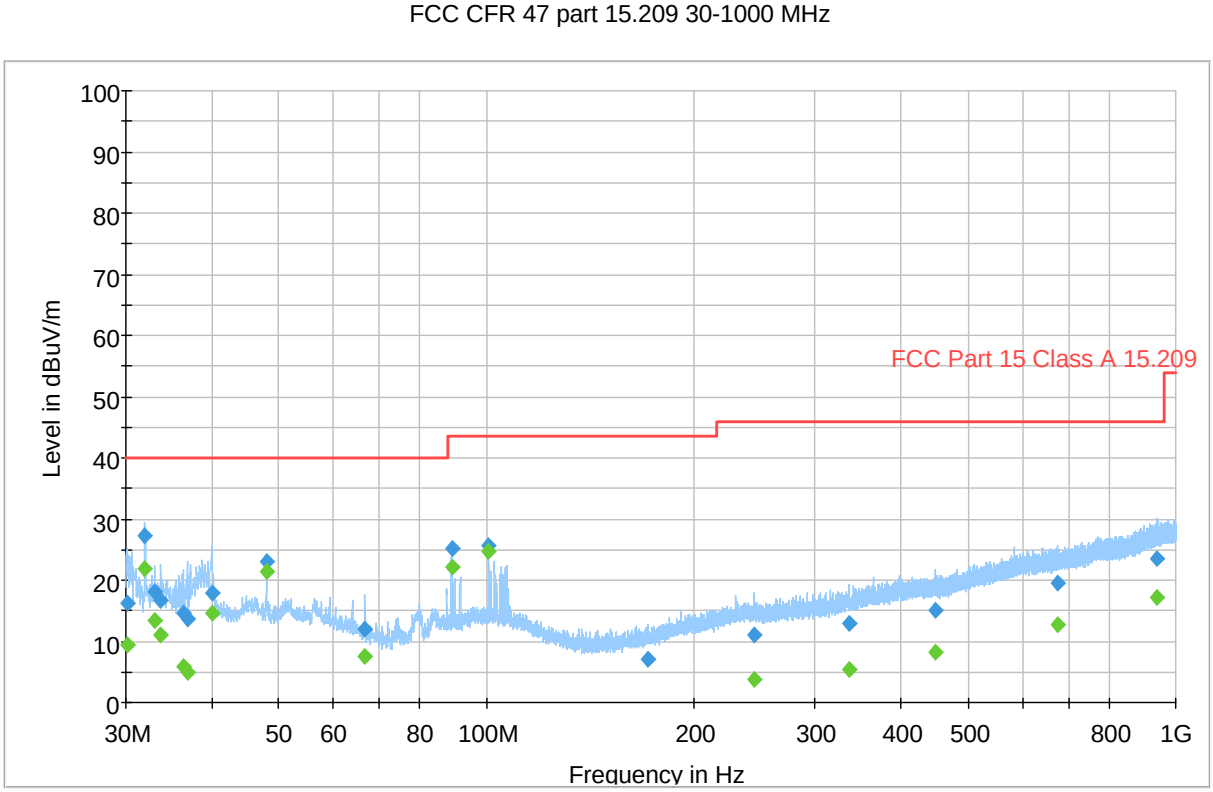
3.8.1 Test procedure

1) The EUT was placed on a turn table top 0.8 m above the floor.
2) The EUT was set 3 meters from the interference receiving antenna which was mounted on the top of a variable height antenna tower.
3) The table was rotated 360 degrees to determine the position of the highest radiation.
4) The antenna is a broadband antenna and its height is varied between 1 meter and 4 meters above the floor to find the maximum value of the shield strength for both horizontal polarization and vertical polarization of the antenna.
5) For each suspected emission, the EUT was arranged to its worst case.
6) On any frequency or frequencies below or equal to 1000 MHz the test-receiver was set to Quasi-peak detector function with specified bandwidth with maximum hold mode.
7) On any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function and peak detector function. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to EUT. Measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz.

3.8.2 Test result radiated emission from receiver part

Temperature: +18 °C	Relative humidity: 69 %
Mode	Receiver on

Frequency 2481 (worst case)
Below 1 GHz



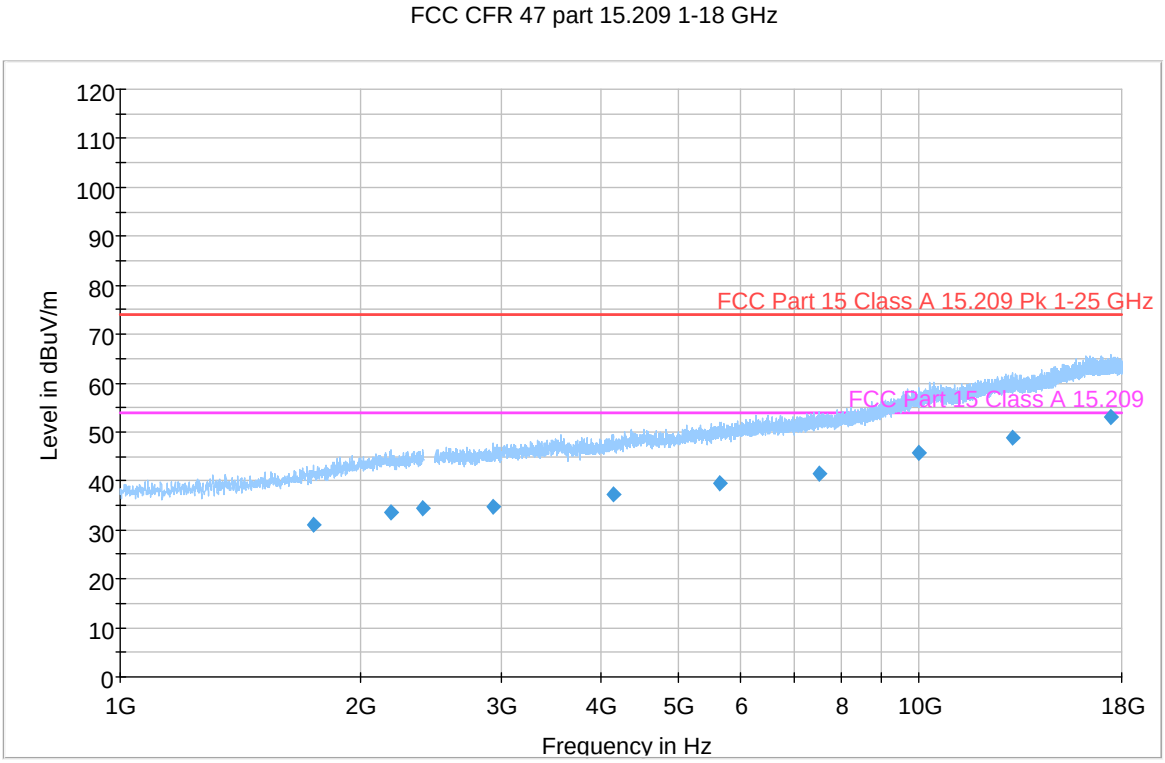
Final Result 1

Frequency (MHz)	QuasiPeak (dBuV/m)	Height (cm)	Polarization	Corr. (dB)	Margin (dB)	Limit (dBuV/m)
30.080000	16.3	150.0	V	-13.3	23.7	40.0
32.000000	27.3	100.0	V	-13.3	12.7	40.0
33.000000	18.1	100.0	V	-13.3	21.9	40.0
33.720000	16.7	100.0	V	-13.3	23.3	40.0
36.280000	14.5	150.0	V	-12.9	25.5	40.0
36.800000	13.7	100.0	V	-12.8	26.3	40.0
39.960000	17.8	100.0	V	-12.0	22.2	40.0
48.000000	23.2	100.0	V	-12.1	16.8	40.0
66.680000	11.9	100.0	V	-15.3	28.1	40.0
89.120000	25.3	100.0	V	-13.6	18.2	43.5
100.80000	25.7	100.0	V	-12.2	17.8	43.5
171.48000	7.0	100.0	H	-15.9	36.5	43.5
244.92000	11.1	100.0	H	-11.7	34.9	46.0
335.40000	12.9	250.0	V	-10.2	33.1	46.0
448.72000	15.1	200.0	V	-7.9	30.9	46.0
675.24000	19.6	350.0	H	-3.9	26.4	46.0
941.60000	23.6	350.0	V	-0.4	22.4	46.0

Final Result 2

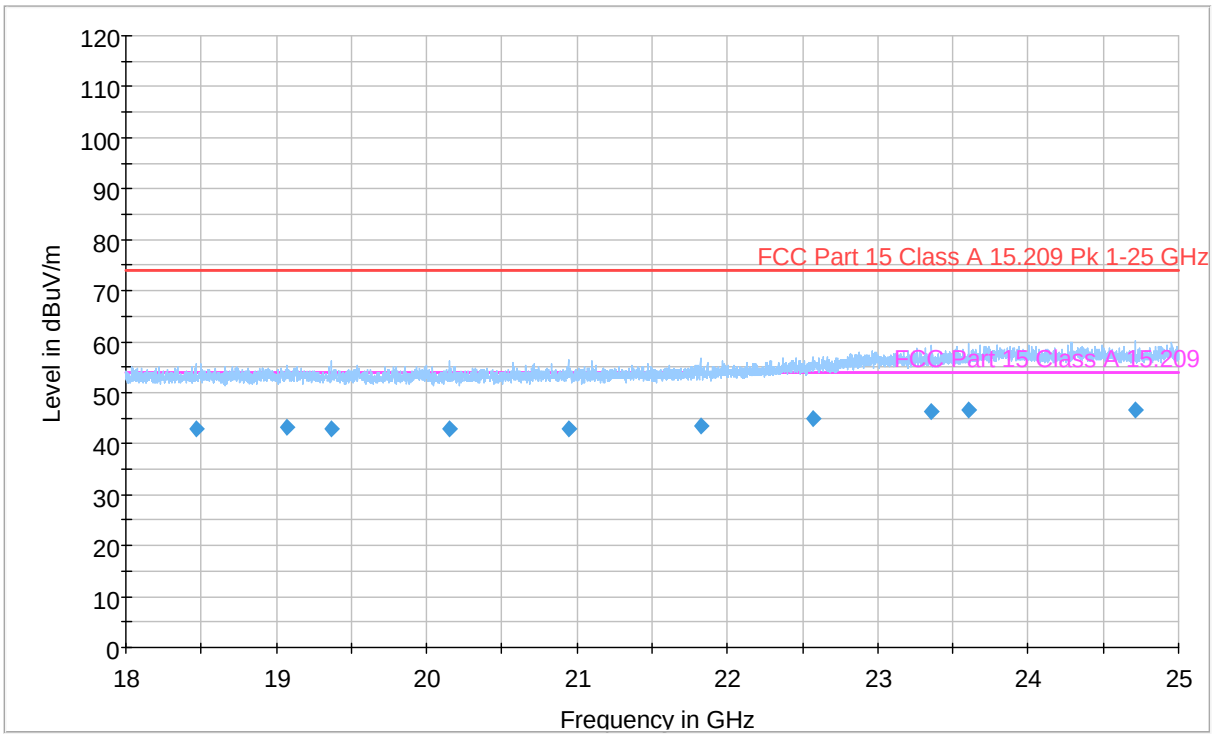
Frequency (MHz)	Average (dBuV/m)	Height (cm)	Polarization	Corr. (dB)	Margin (dB)	Limit (dBuV/m)
30.080000	9.5	150.0	V	-13.3	30.5	40.0
32.000000	21.9	100.0	V	-13.3	18.1	40.0
33.000000	13.3	100.0	V	-13.3	26.7	40.0
33.720000	11.1	100.0	V	-13.3	28.9	40.0
36.280000	5.9	150.0	V	-12.9	34.1	40.0
36.800000	4.9	100.0	V	-12.8	35.1	40.0
39.960000	14.6	100.0	V	-12.0	25.4	40.0
48.000000	21.5	100.0	V	-12.1	18.5	40.0
66.680000	7.6	100.0	V	-15.3	32.4	40.0
89.120000	22.0	100.0	V	-13.6	21.5	43.5
100.800000	24.8	100.0	V	-12.2	18.7	43.5
171.480000	-0.5	100.0	H	-15.9	44	43.5
244.920000	3.8	100.0	H	-11.7	42.2	46.0
335.400000	5.4	250.0	V	-10.2	40.6	46.0
448.720000	8.2	200.0	V	-7.9	37.8	46.0
675.240000	12.6	350.0	H	-3.9	33.4	46.0
941.600000	17.2	350.0	V	-0.4	28.8	46.0

Above 1 GHz



Final Result 3

Frequency (MHz)	Average (dBuV/m)	Height (cm)	Polarization	Corr. (dB)	Margin (dB)	Limit (dBuV/m)
1748.000000	31.1	100.0	H	9.9	22.9	54.0
2186.000000	33.7	100.0	H	12.4	20.3	54.0
2392.000000	34.4	100.0	V	13.1	19.6	54.0
2936.000000	34.8	100.0	H	14.3	19.2	54.0
4146.000000	37.3	100.0	V	17.3	16.7	54.0
5638.000000	39.6	100.0	H	20.3	14.4	54.0
7526.000000	41.5	100.0	V	23.2	12.5	54.0
10017.00000	45.7	100.0	H	27.0	8.3	54.0
13130.00000	48.9	100.0	V	30.8	5.1	54.0
17439.00000	53.0	100.0	H	35.2	1.0	54.0



Final Result 4

Frequency (MHz)	Average (dBuV/m)	Height (cm)	Polarization	Corr. (dB)	Margin (dB)	Limit (dBuV/m)
18466.00000	42.8	100.0	H	20.0	11.2	54.0
19074.00000	43.2	100.0	H	20.6	10.8	54.0
19366.00000	43.0	100.0	V	20.8	11.0	54.0
20149.00000	42.8	100.0	V	21.3	11.2	54.0
20941.00000	43.0	100.0	V	21.7	11.0	54.0
21821.00000	43.6	100.0	H	22.4	10.4	54.0
22567.00000	44.8	100.0	H	23.7	9.2	54.0
23359.00000	46.3	100.0	V	24.8	7.7	54.0
23607.00000	46.6	100.0	H	24.9	7.4	54.0
24714.00000	46.6	100.0	V	25.3	7.4	54.0

3.9 Antenna Requirement

3.9.1 Test procedure

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

The antenna of the Transmitter Module Typ-K permanently attached and there are no provisions for connection to an external antenna. It complies with the requirement of §15.203.

3.10 RF exposure

3.10.1 General

This test was performed to determine the minimum safe distance between the transmitter antenna and human to avoid public exposure in excess of limits for general population (uncontrolled exposure). Specification test limits are given in Table 3.10.1. Test procedure: §1.1307(b)(1).

Table 3.10.1 — Limits For Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3-3.0	614	1.63	*100	6
3.0-30	1842/f	4.89/f	$*900/f^2$	6
30-300	61.4	0.163	1.0	6
300-1,500	-	-	f/300	6
1,500-100,000	-	-	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*100	30
1.34-30	824/f	2.19/f	$*180/f^2$	30
30-300	27.5	0.073	0.2	30
300-1,500	-	-	f/1500	30
1,500-100,000	-	-	1.0	30

f = frequency in MHz * = Plane-wave equivalent power density

3.10.2 Test procedure: 47 CRF, §1.1307(b)(1).

3.10.3 Power density calculation for mobile transmitter

The power density at the specified distance was calculated from the following equation:

$$S = \frac{PG}{4\pi R^2},$$

where

S = power density (mW/cm^2)
P = average power input to the antenna over averaging time (mW)
G = power gain of the antenna in the direction of interest relative to an isotropic radiator (numeric)
R = distance to the center of radiation of the antenna (cm)

Power density calculation for duty cycle 25 %:

$$S = \frac{0.25 \times 100 \times 1}{4 \times \pi \times 20^2} = 0.005\ [mW/cm^2]$$

Frequency range, MHz	Maximum output power, dBm	Antenna gain, dBi	EIRP		Power density, mW/m^2	Limit, mW/cm^2	Margin, mW/cm^2	Verdict
			dBm	mW				
2.400 - 2.4835	20	0	20	100	0.005	1.0	0.995	Pass

The equipment is intended for use at a distance of more than 20 cm from humans.