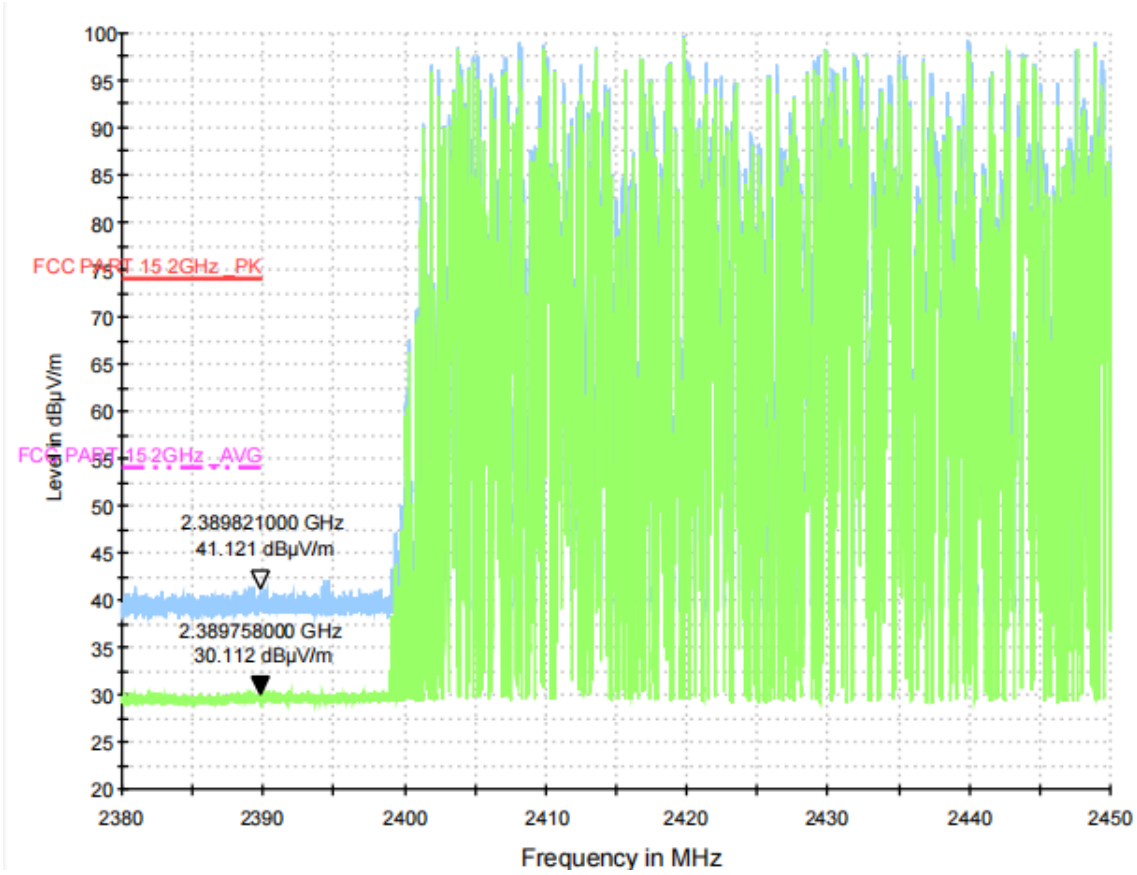
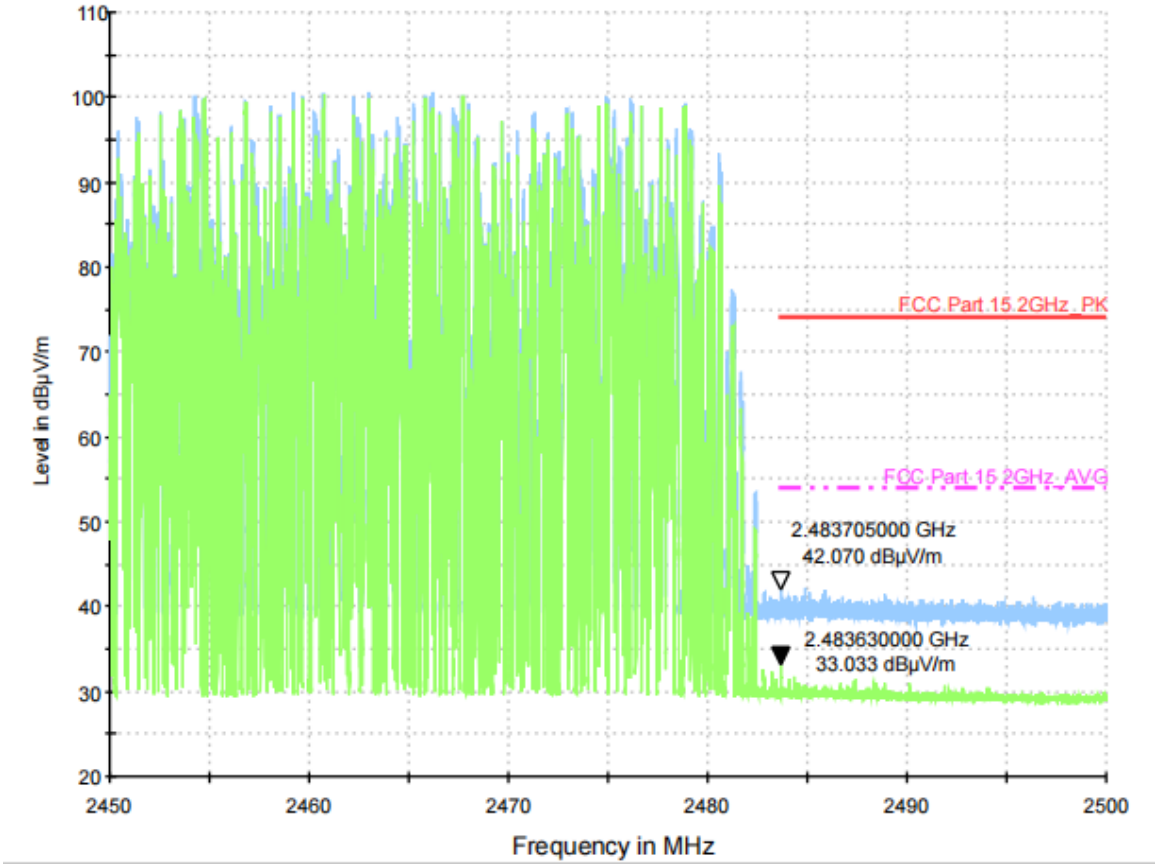
Test Mode	1Mbps (Hopping)	Polarization	Vertical/ Horizontal



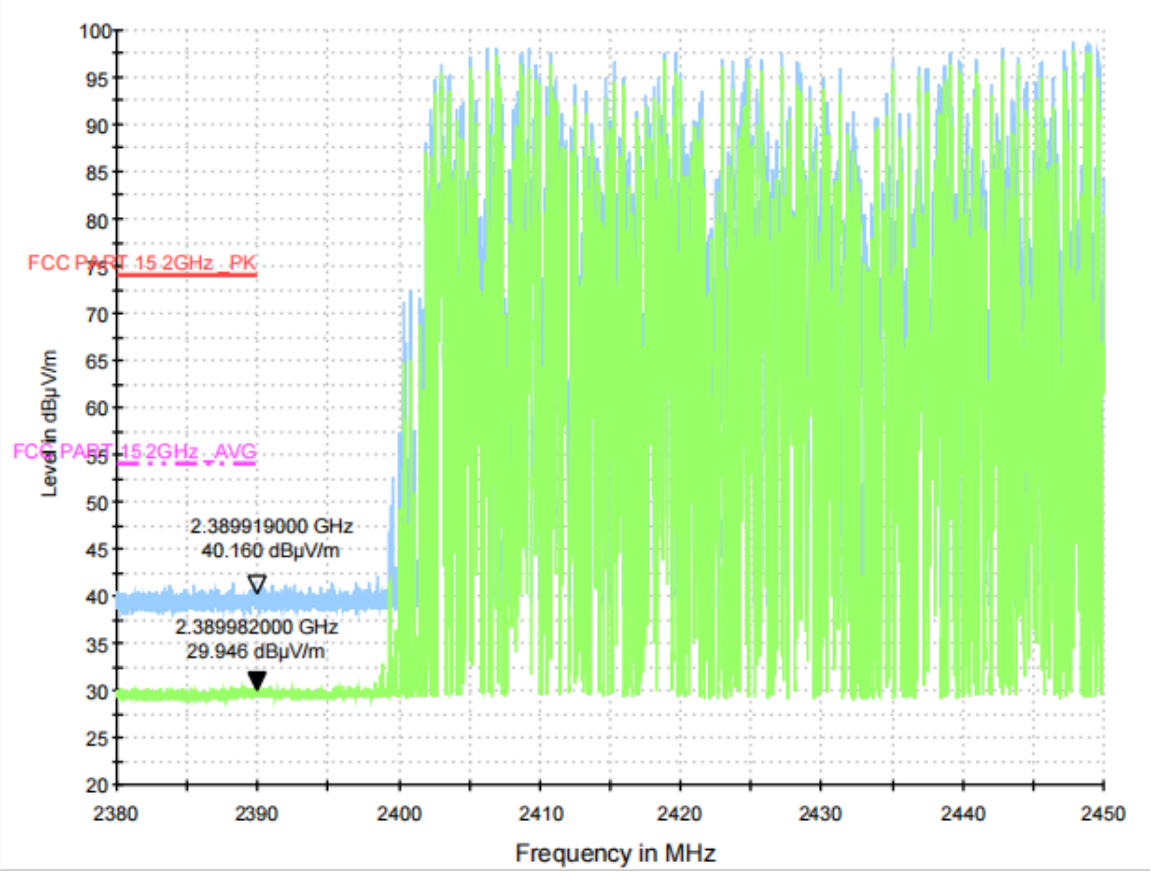
REMARKS:
(1) Measurement Value = Reading Level + Correct Factor.
(2) Margin Level = Measurement Value - Limit Value.
(3) Test plots include horizontal and vertical polarization.

Test Mode	1Mbps (Hopping)	Polarization	Vertical/ Horizontal



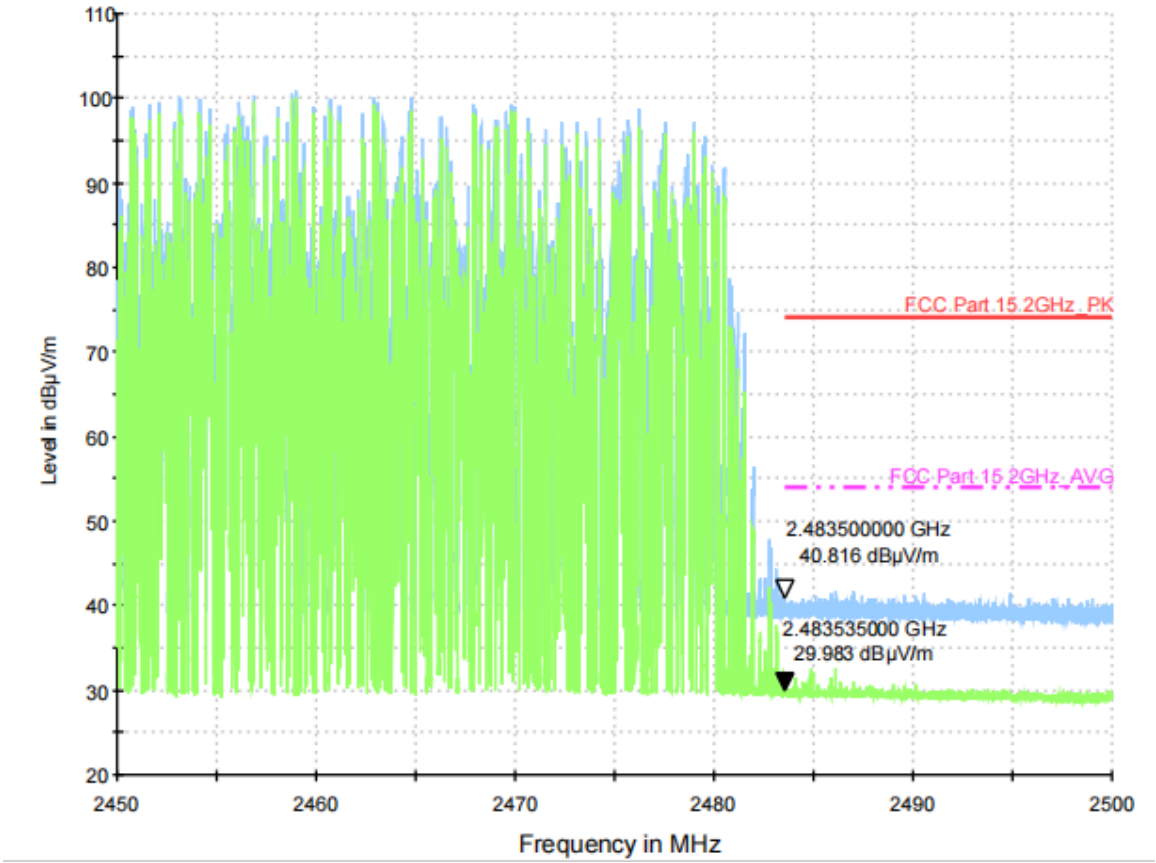
REMARKS:
(1) Measurement Value = Reading Level + Correct Factor.
(2) Margin Level = Measurement Value - Limit Value.
(3) Test plots include horizontal and vertical polarization.

Test Mode	2Mbps (Hopping)	Polarization	Vertical/ Horizontal



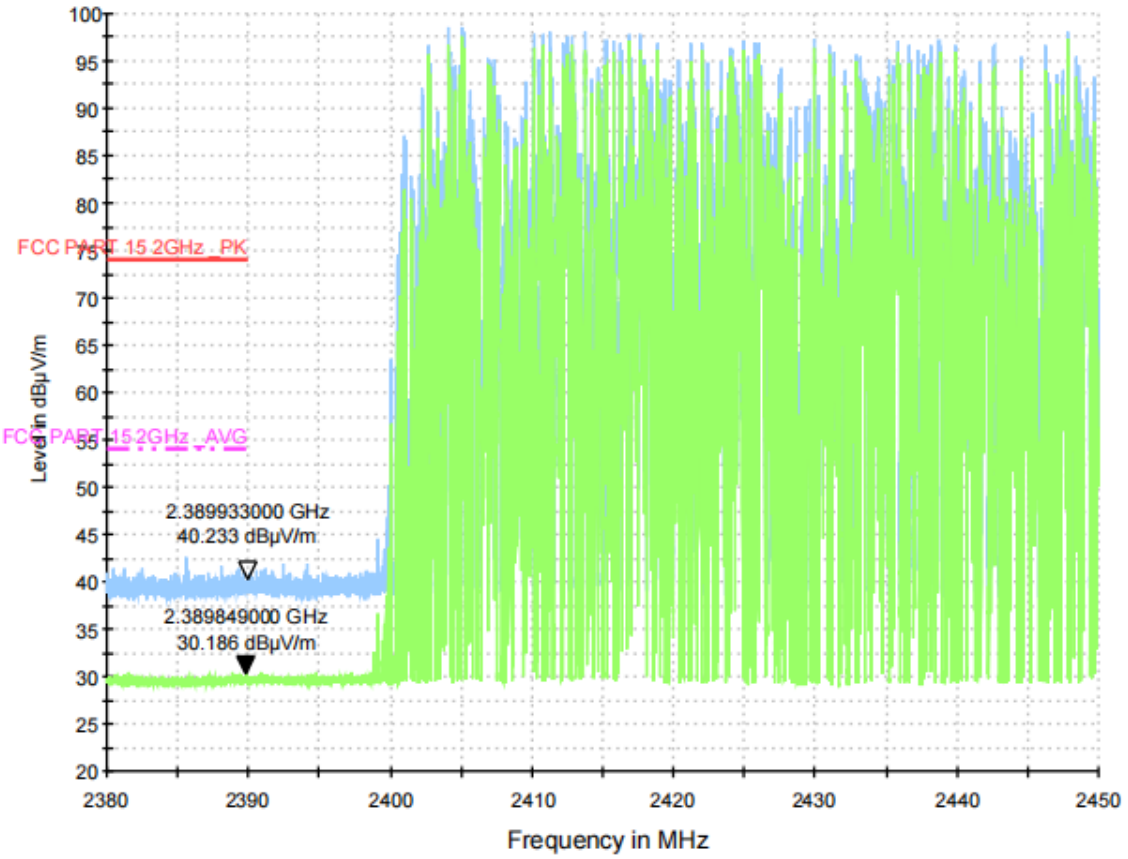
REMARKS:
(1) Measurement Value = Reading Level + Correct Factor.
(2) Margin Level = Measurement Value - Limit Value.
(3) Test plots include horizontal and vertical polarization.

Test Mode	2Mbps (Hopping)	Polarization	Vertical/ Horizontal



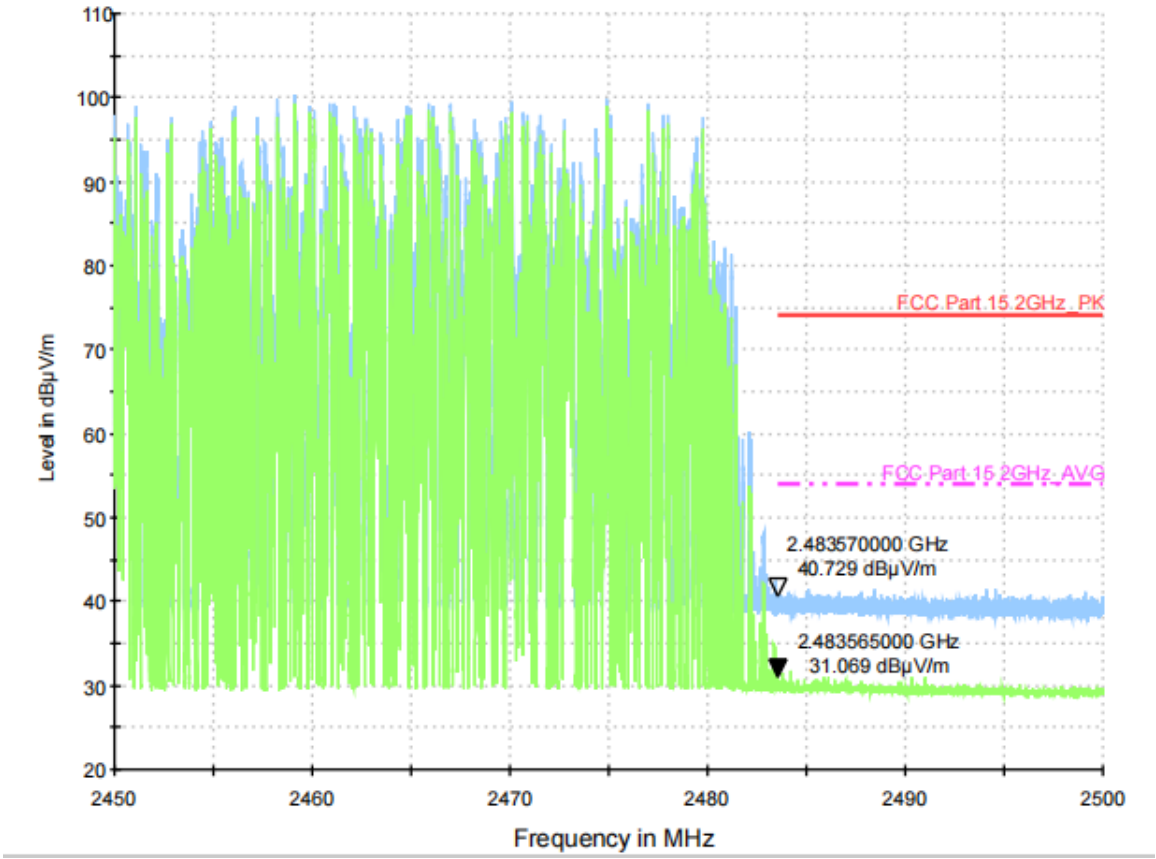
REMARKS:
(1) Measurement Value = Reading Level + Correct Factor.
(2) Margin Level = Measurement Value - Limit Value.
(3) Test plots include horizontal and vertical polarization.

Test Mode	3Mbps (Hopping)	Polarization	Vertical/ Horizontal



REMARKS:
(1) Measurement Value = Reading Level + Correct Factor.
(2) Margin Level = Measurement Value - Limit Value.
(3) Test plots include horizontal and vertical polarization.

Test Mode	3Mbps (Hopping)	Polarization	Vertical/ Horizontal



REMARKS:
(1) Measurement Value = Reading Level + Correct Factor.
(2) Margin Level = Measurement Value - Limit Value.
(3) Test plots include horizontal and vertical polarization.

ABOVE 1000 MHz

Modulation Type: DH5(GFSK)

Note: All the modes have been tested and recorded worst mode in the report.

Low channel:2402									
Frequency	Ant.Pol. H/V	Peak reading (dBuV)	AV reading (dBuV)	Correction Factor	Emission Level		Peak Limit (dBuV/m)	AV Limit (dBuV/m)	Margin (dB)
					Peak (dBuV/m)	AV (dBuV/m)			
4804.25	H	54.47		-1.99	52.48	---	74	54	-21.52
7206.31	H	40.13	---	7.14	47.27	---	75	55	-6.73
---	H	---	---	---	---	---	---	---	---
4804.47	V	56.58	42.82	-1.99	54.59	40.83	74	54	-19.41
7206.21	V	39.12	---	7.14	46.26	---	74	54	-7.74
---	V	---	---	---	---	---	---	---	---

Notes:

1). Radiated emissions measured in frequency range from 9 KHz~10th harmonic or 26.5GHz (which is less) were made with an instrument using Peak detector mode.

2). Data of measurement within this frequency range shown "---" in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

3). Measured Level = Reading Level + Correction Factor, Margin = Measured Level – Limit

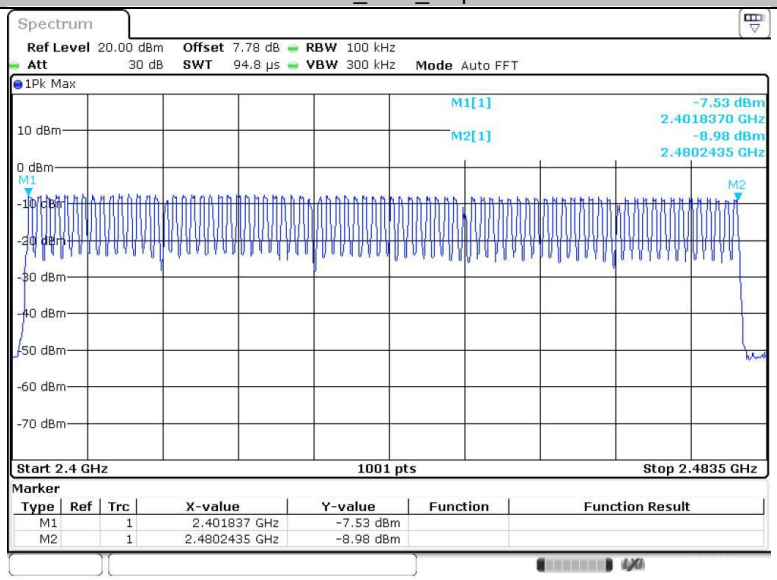
4). this report only show the worst mode dat , Worst case data at 1Mbps at DH5(GFSK).

APPENDIX E - NUMBER OF HOPPING FREQUENCY

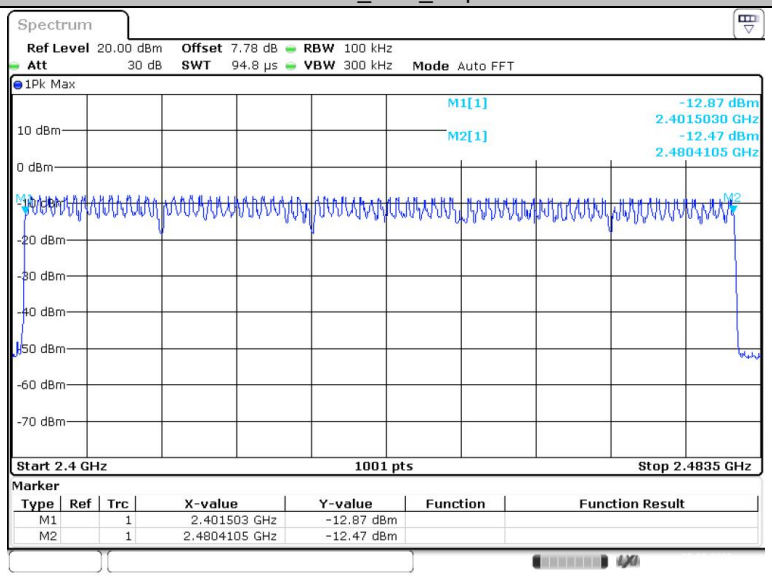
TestMode	Antenna	Freq(MHz)	Result[Num]	Limit[Num]	Verdict
DH5	Ant1	Hop	79	≥15	PASS
2DH5	Ant1	Hop	79	≥15	PASS
3DH5	Ant1	Hop	79	≥15	PASS

Test Graphs

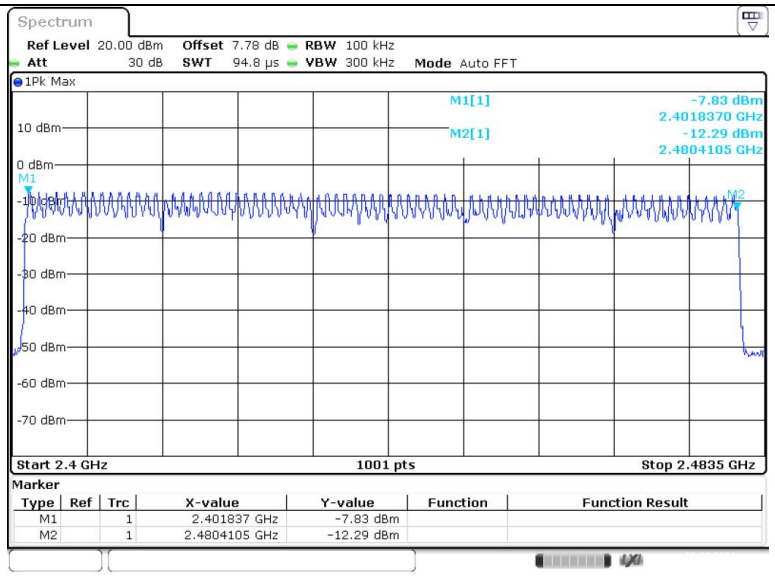
DH5_Ant1_Hop



2DH5_Ant1_Hop



3DH5_Ant1_Hop


Spectrum
Ref Level 20.00 dBm Offset 7.78 dB RBW 100 kHz
Att 30 dB SWT 94.8 µs VBW 300 kHz Mode Auto FFT
1Pk Max
M1[1] -7.83 dBm
2.4018370 GHz
M2[1] -12.29 dBm
2.4804105 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
M2
Start 2.4 GHz
1001 pts
Stop 2.4835 GHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.401837 GHz -7.83 dBm
M2 1 2.4804105 GHz -12.29 dBm

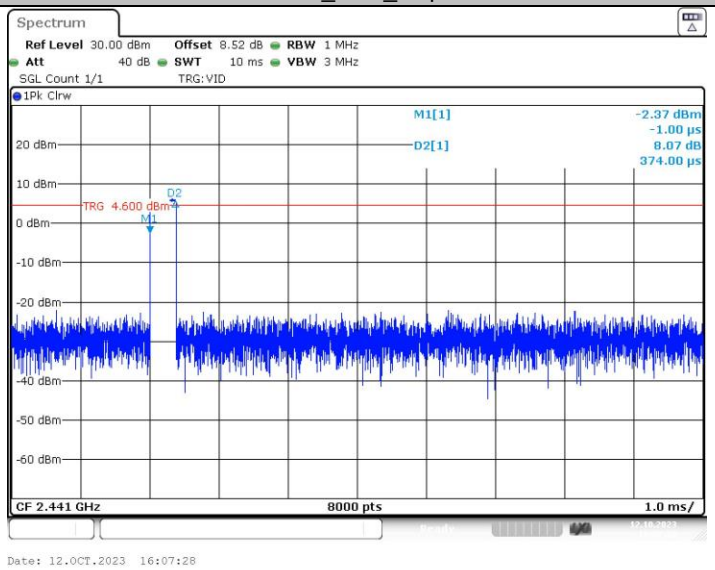
APPENDIX F - AVERAGE TIME OF OCCUPANCY

Test Mode	Hopping Mode_1Mbps

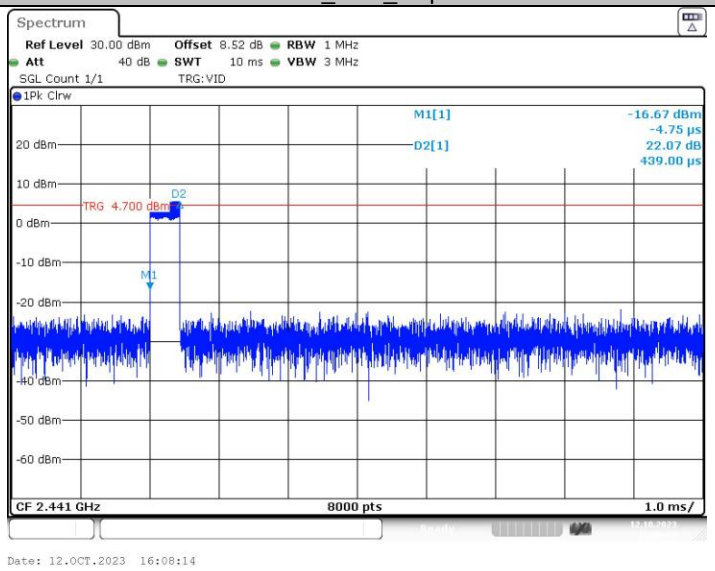
TestMode	Antenna	Freq(MHz)	BurstWidth [ms]	TotalHops [Num]	Result[s]	Limit[s]	Verdict
DH1	Ant1	Hop	0.374	320	0.12	≤0.4	PASS
DH3	Ant1	Hop	0.439	160	0.07	≤0.4	PASS
DH5	Ant1	Hop	2.863	106.67	0.305	≤0.4	PASS
2DH1	Ant1	Hop	0.383	320	0.123	≤0.4	PASS
2DH3	Ant1	Hop	1.625	160	0.26	≤0.4	PASS
2DH5	Ant1	Hop	2.865	106.67	0.306	≤0.4	PASS
3DH1	Ant1	Hop	0.383	320	0.123	≤0.4	PASS
3DH3	Ant1	Hop	1.624	160	0.26	≤0.4	PASS
3DH5	Ant1	Hop	2.868	106.67	0.306	≤0.4	PASS

Test Graphs

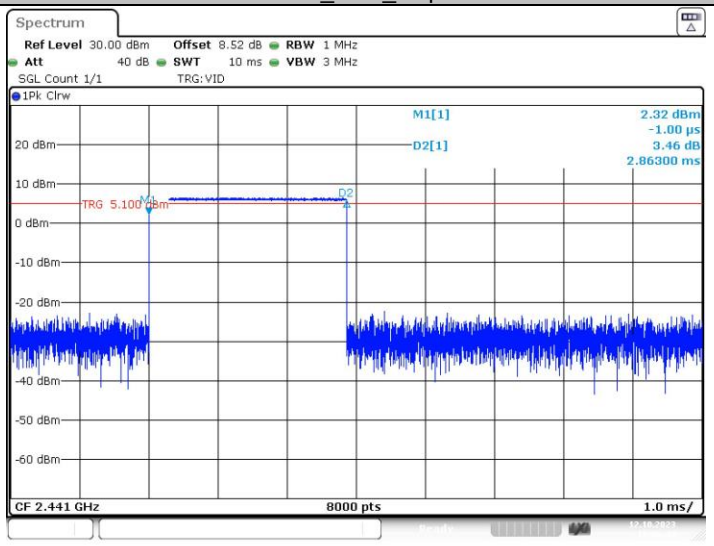
DH1_Ant1_Hop



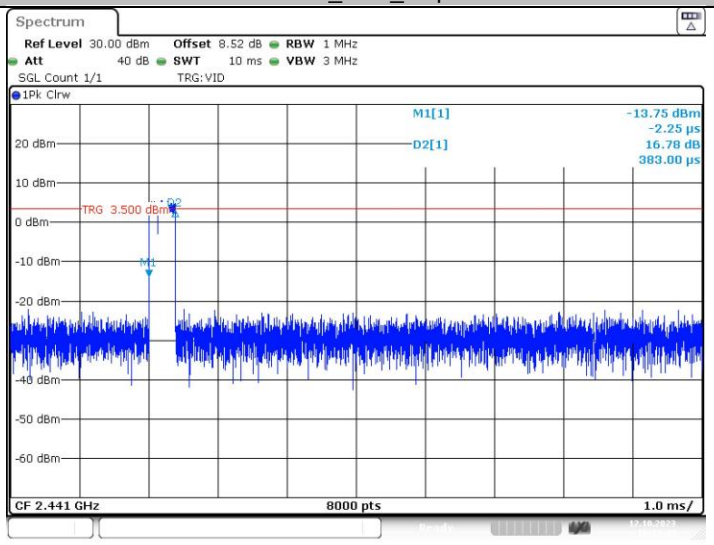
DH3_Ant1_Hop



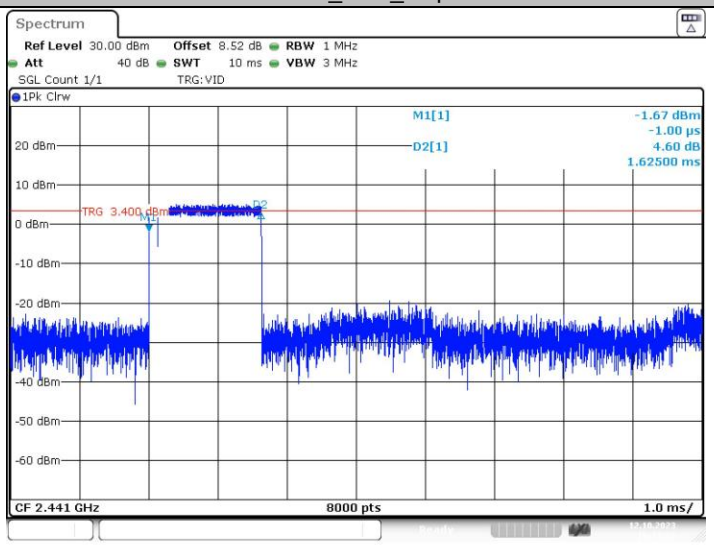
DH5_Ant1_Hop



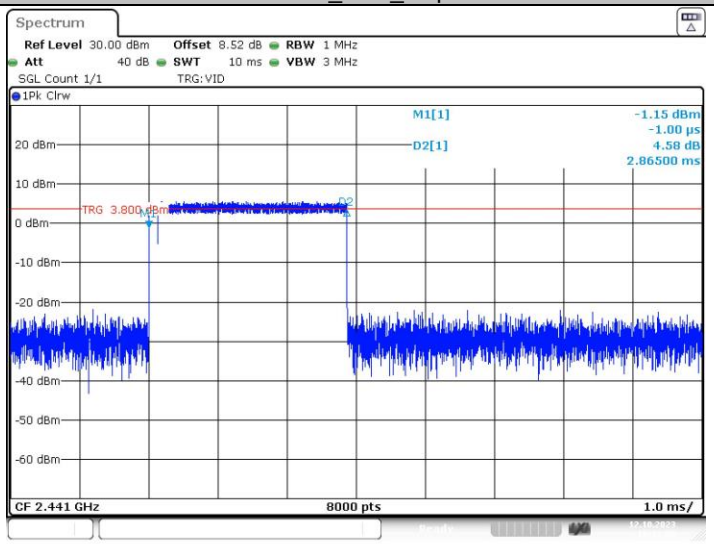
2DH1_Ant1_Hop



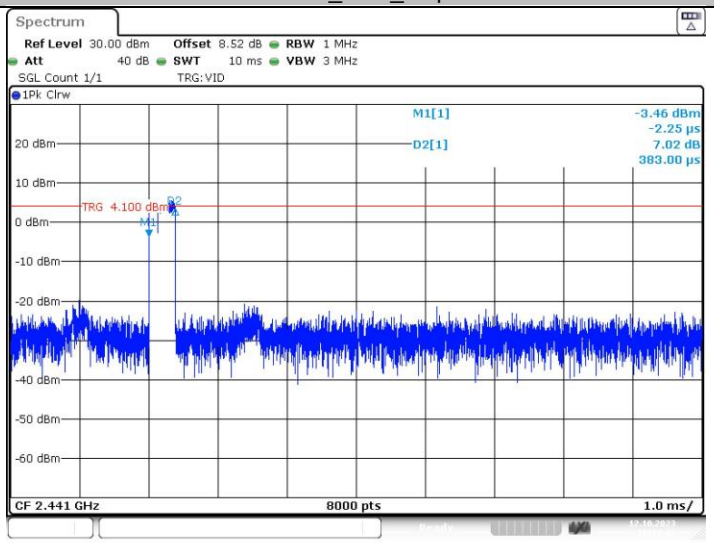
2DH3_Ant1_Hop



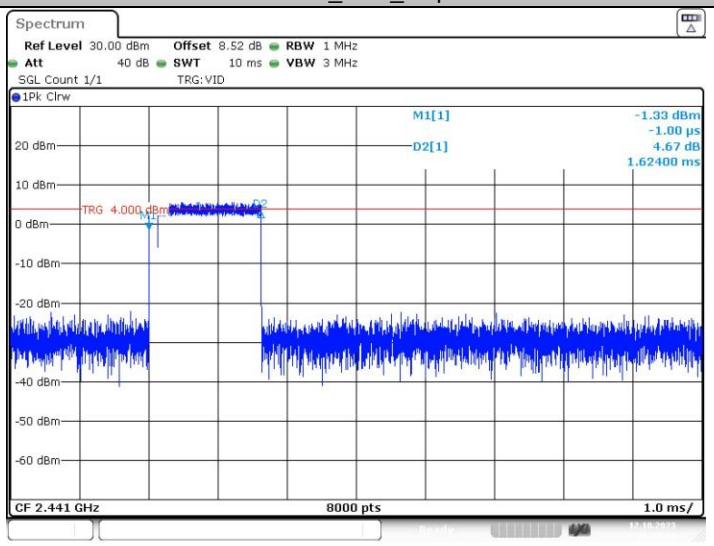
2DH5_Ant1_Hop

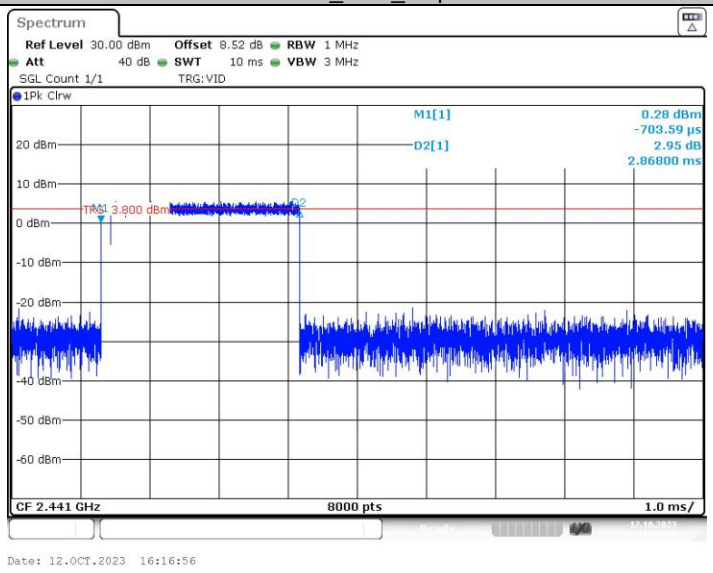


3DH1_Ant1_Hop



3DH3_Ant1_Hop



3DH5_Ant1_Hop


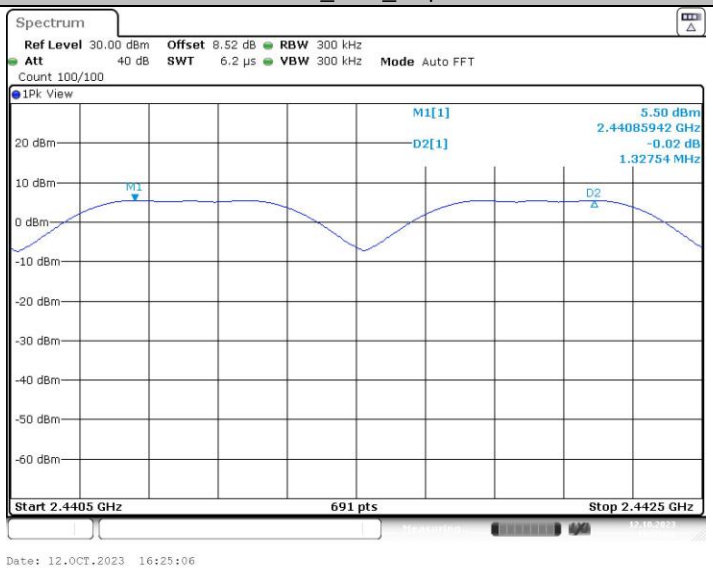
APPENDIX G - HOPPING CHANNEL SEPARATION

Test Mode	Hopping Mode_1Mbps

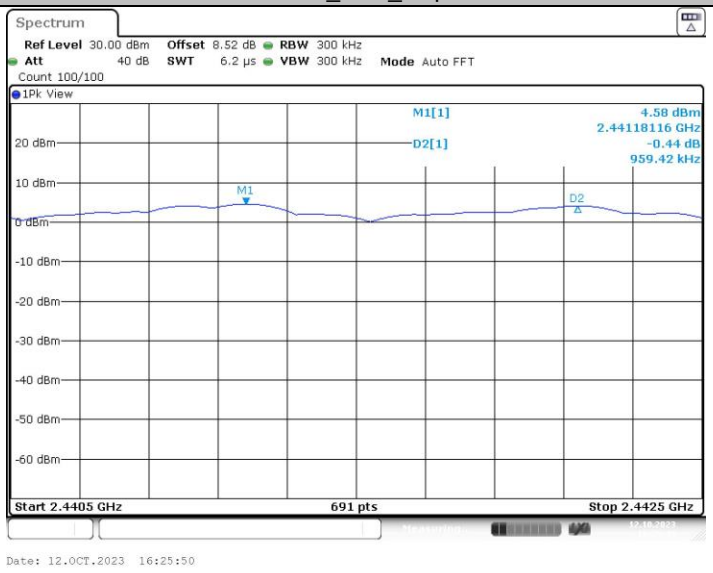
TestMode	Antenna	Freq(MHz)	Result[MHz]	Limit[MHz]	Verdict
DH5	Ant1	Hop	1.328	≥1.040	PASS
2DH5	Ant1	Hop	0.959	≥0.860	PASS
3DH5	Ant1	Hop	1.041	≥0.860	PASS

Test Graphs

DH5_Ant1_Hop



2DH5_Ant1_Hop



3DH5_Ant1_Hop

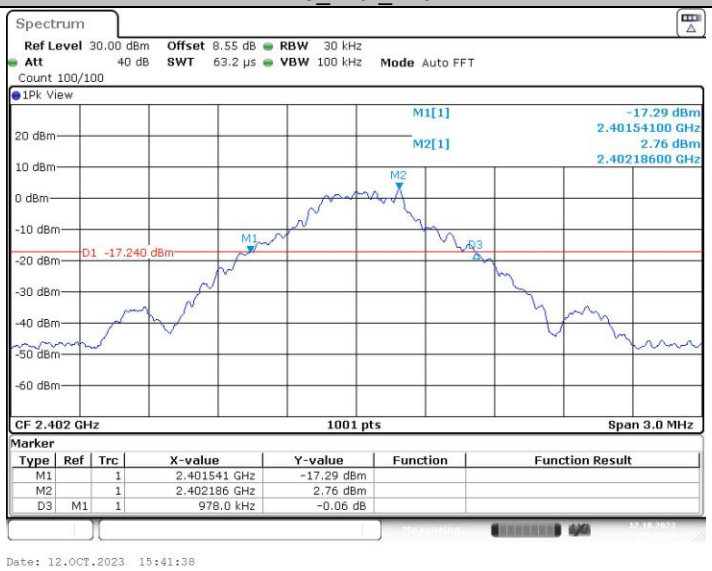
APPENDIX H - BANDWIDTH

1. 20dB Emission Bandwidth

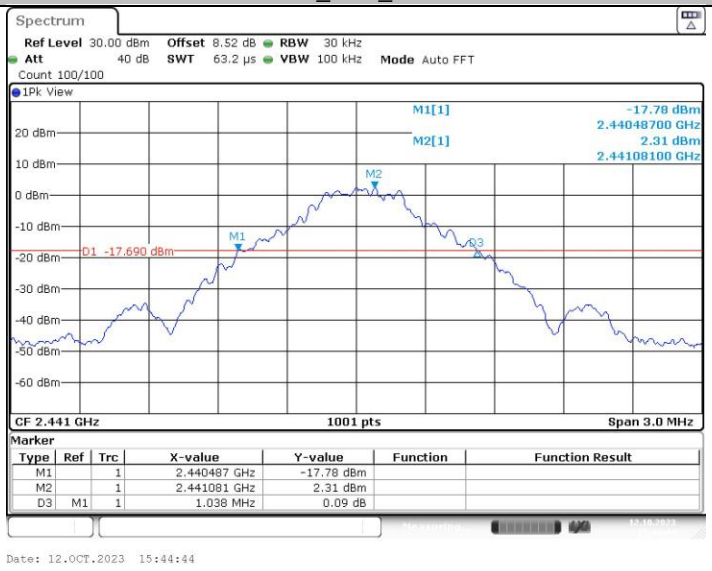
TestMode	Antenna	Freq(MHz)	20dB EBW[MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
DH5	Ant1	2402	0.98	2401.54	2402.52	---	---
		2441	1.04	2440.49	2441.53	---	---
		2480	0.98	2479.54	2480.52	---	---
2DH5	Ant1	2402	1.29	2401.39	2402.68	---	---
		2441	1.28	2440.39	2441.68	---	---
		2480	1.29	2479.39	2480.68	---	---
3DH5	Ant1	2402	1.29	2401.38	2402.67	---	---
		2441	1.28	2440.38	2441.66	---	---
		2480	1.28	2479.38	2480.66	---	---

Test Graphs

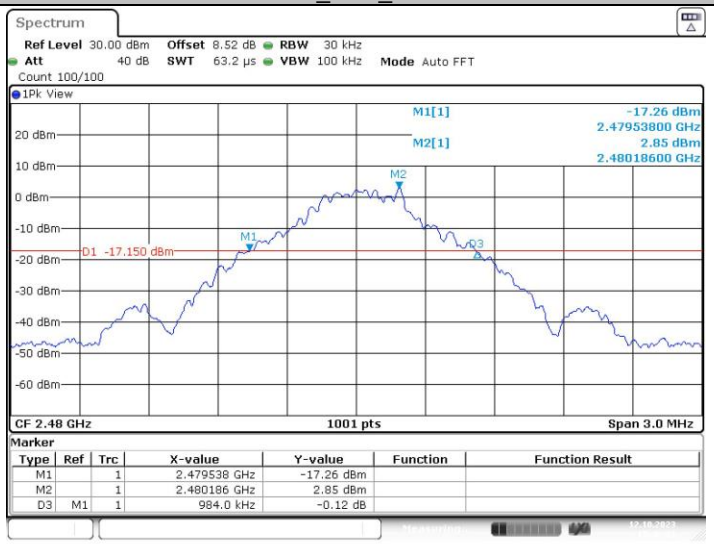
DH5_Ant1_2402



DH5_Ant1_2441

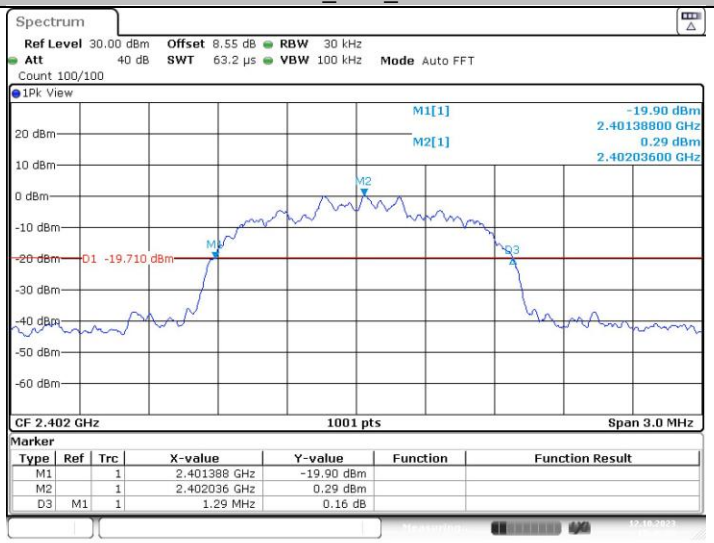


DH5_Ant1_2480



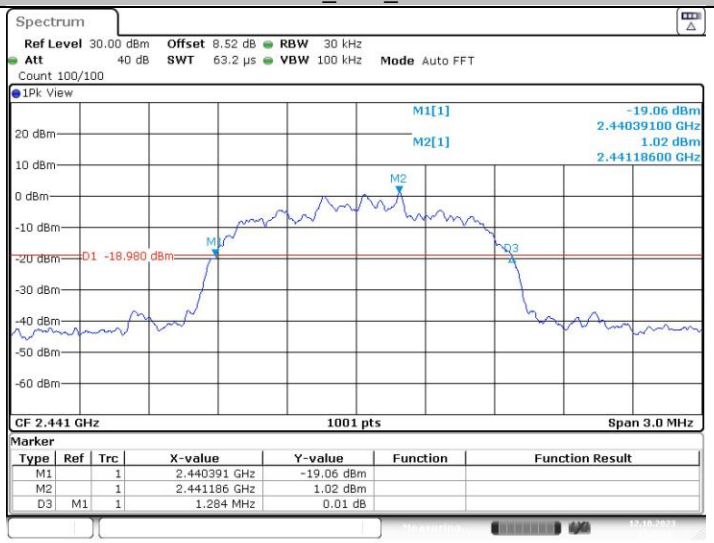
Date: 12.OCT.2023 15:46:33

2DH5_Ant1_2402



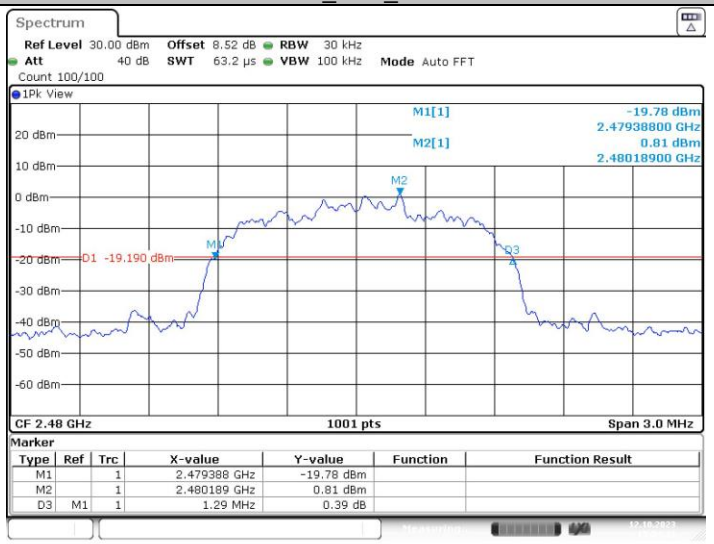
Date: 12.OCT.2023 15:49:50

2DH5_Ant1_2441



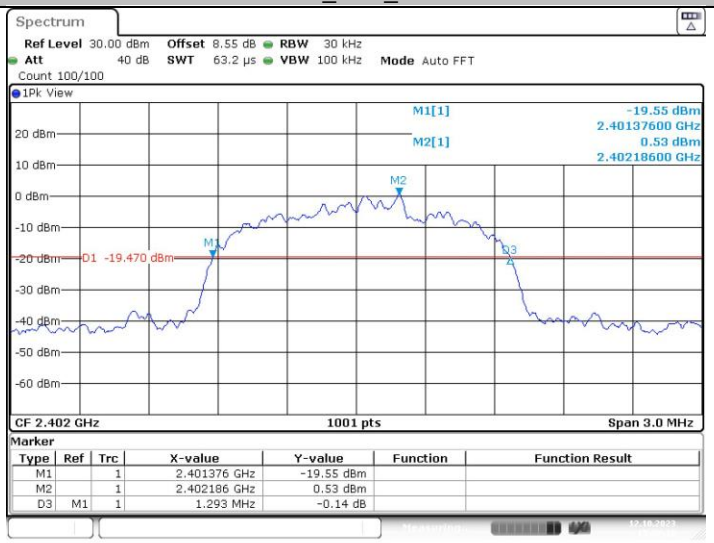
Date: 12.OCT.2023 15:52:41

2DH5_Ant1_2480



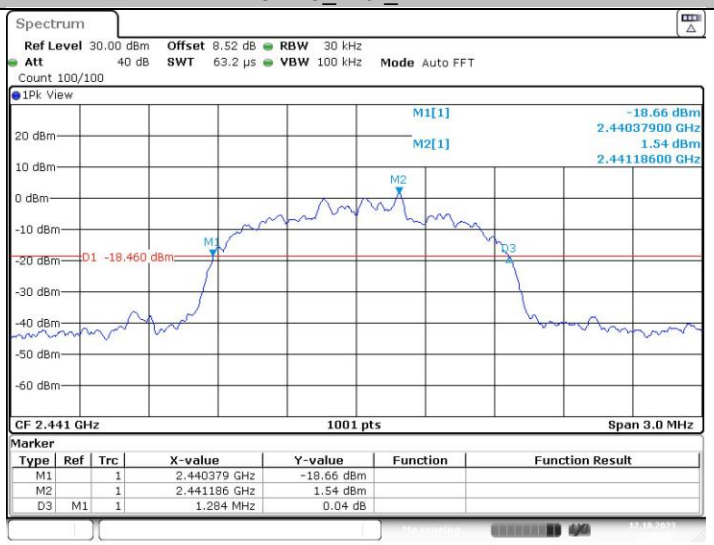
Date: 12.OCT.2023 15:54:13

3DH5_Ant1_2402



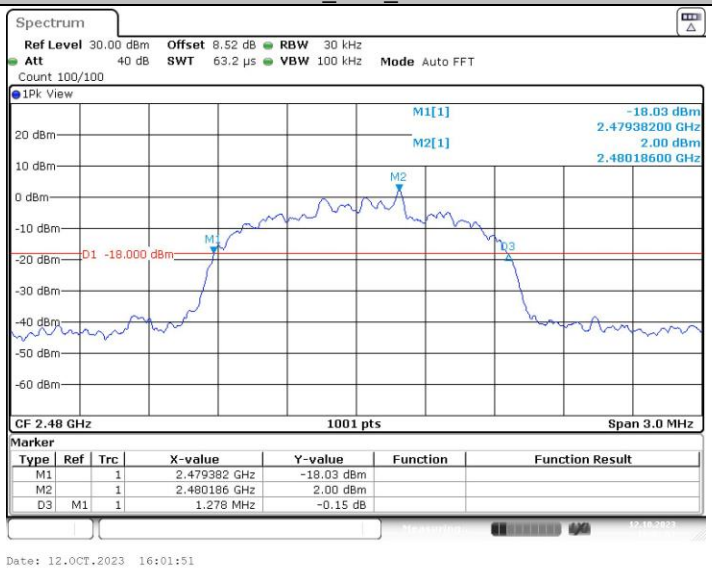
Date: 12.OCT.2023 15:57:19

3DH5_Ant1_2441



Date: 12.OCT.2023 16:00:07

3DH5_Ant1_2480

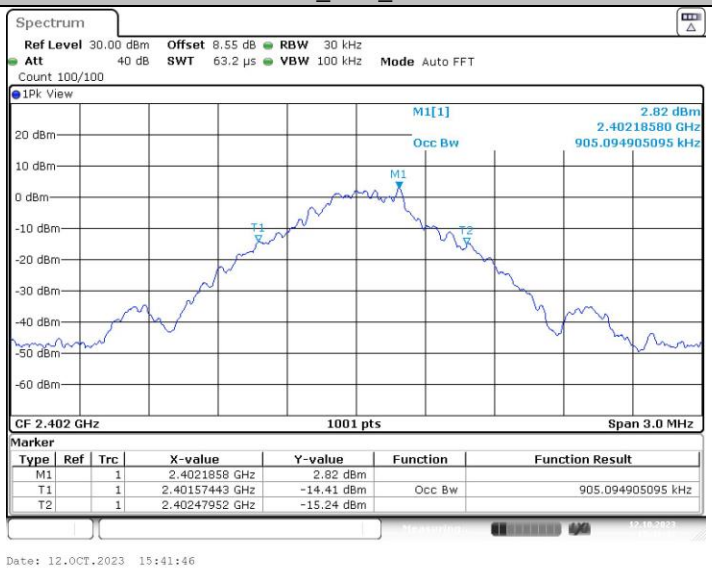


2. Occupied Channel Bandwidth

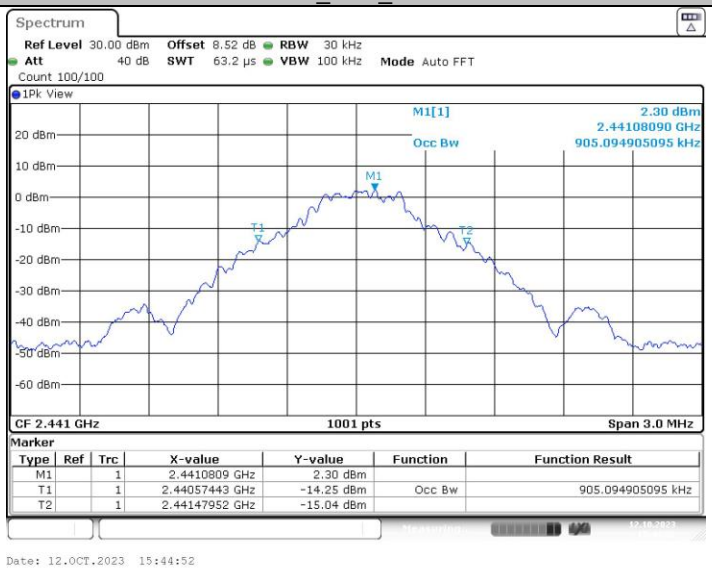
(5) TestMode	Antenna	Freq(MHz)	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
DH5	Ant1	2402	0.905	2401.5744	2402.4795	---	---
		2441	0.905	2440.5744	2441.4795	---	---
		2480	0.896	2479.5774	2480.4735	---	---
2DH5	Ant1	2402	1.169	2401.4366	2402.6054	---	---
		2441	1.169	2440.4366	2441.6054	---	---
		2480	1.169	2479.4366	2480.6054	---	---
3DH5	Ant1	2402	1.169	2401.4396	2402.6084	---	---
		2441	1.172	2440.4396	2441.6114	---	---
		2480	1.166	2479.4426	2480.6084	---	---

Test Graphs

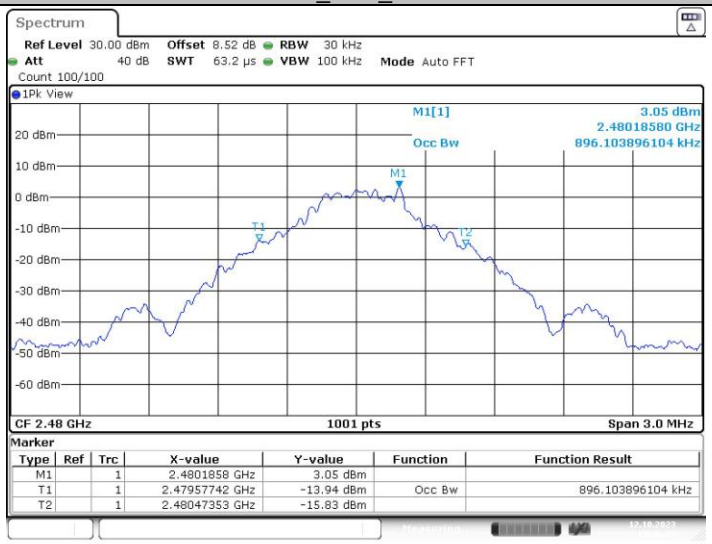
DH5_Ant1_2402



DH5_Ant1_2441

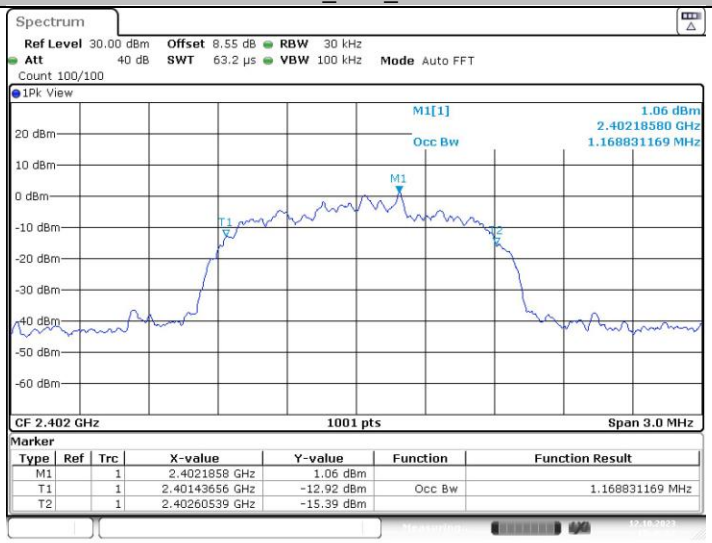


DH5_Ant1_2480



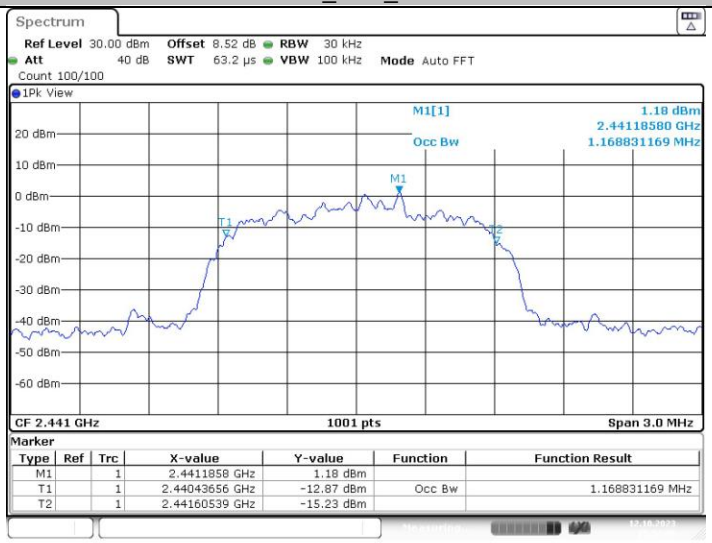
Date: 12.OCT.2023 15:46:41

2DH5_Ant1_2402



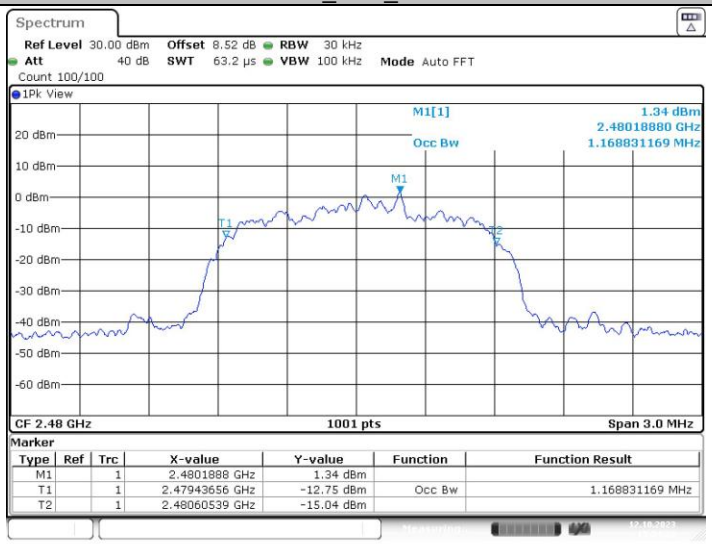
Date: 12.OCT.2023 15:49:58

2DH5_Ant1_2441



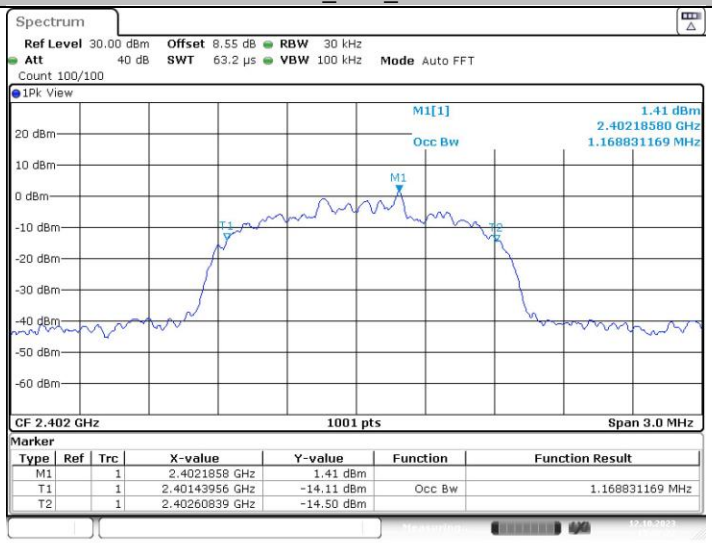
Date: 12.OCT.2023 15:52:49

2DH5_Ant1_2480



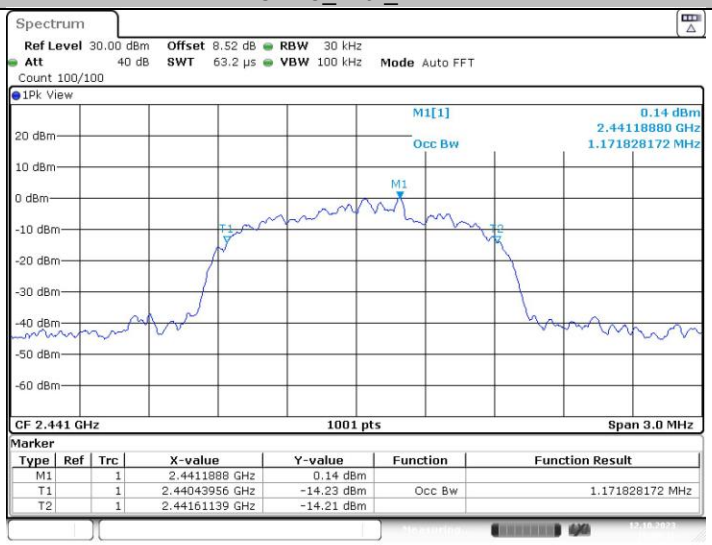
Date: 12.OCT.2023 15:54:20

3DH5_Ant1_2402



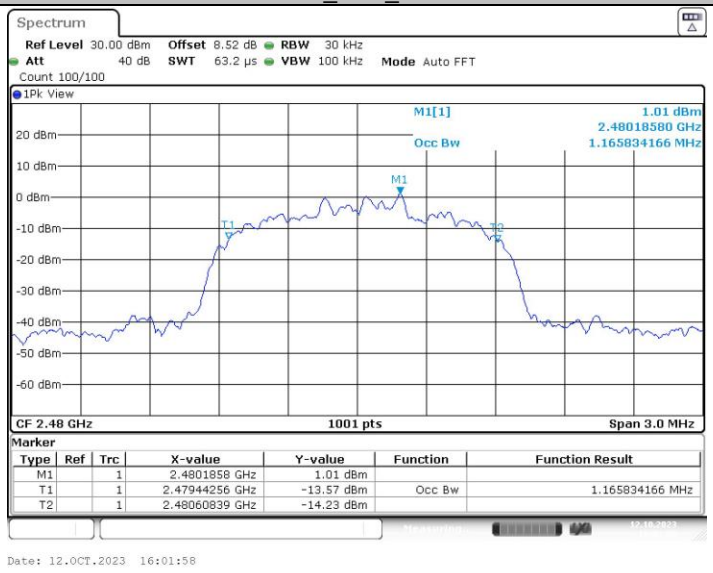
Date: 12.OCT.2023 15:57:27

3DH5_Ant1_2441



Date: 12.OCT.2023 16:00:15

3DH5_Ant1_2480

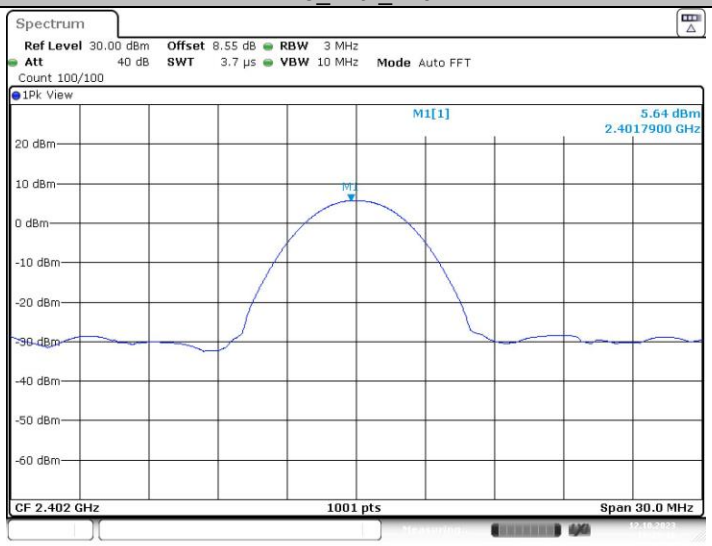


APPENDIX I - MAXIMUM OUTPUT POWER

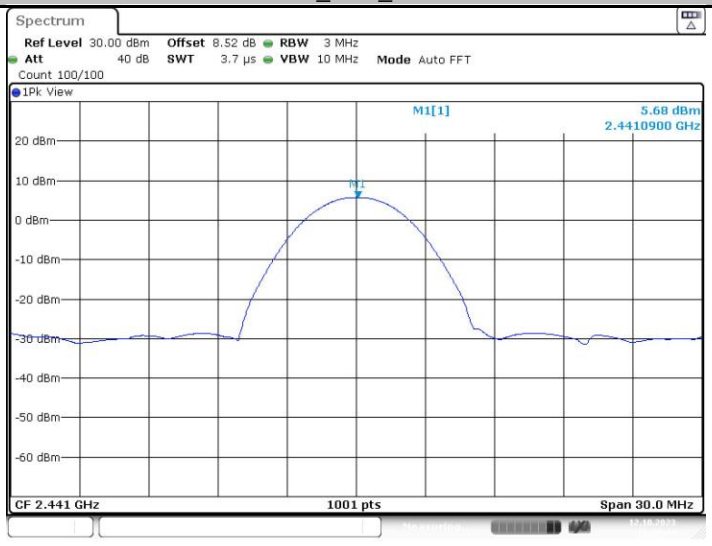
Test Mode	Antenna	Freq(MHz)	Conducted Peak Powert[dBm]	Conducted Limit[dBm]	Verdict
DH5	Ant1	2402	5.64	≤20.97	PASS
		2441	5.68	≤20.97	PASS
		2480	5.83	≤20.97	PASS
2DH5	Ant1	2402	4.76	≤20.97	PASS
		2441	4.76	≤20.97	PASS
		2480	5.38	≤20.97	PASS
3DH5	Ant1	2402	4.92	≤20.97	PASS
		2441	5.34	≤20.97	PASS
		2480	5.44	≤20.97	PASS

Test Graphs

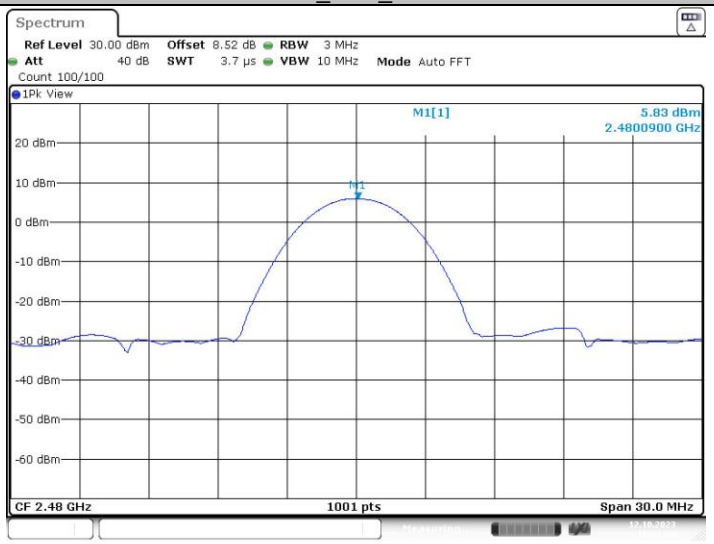
DH5_Ant1_2402



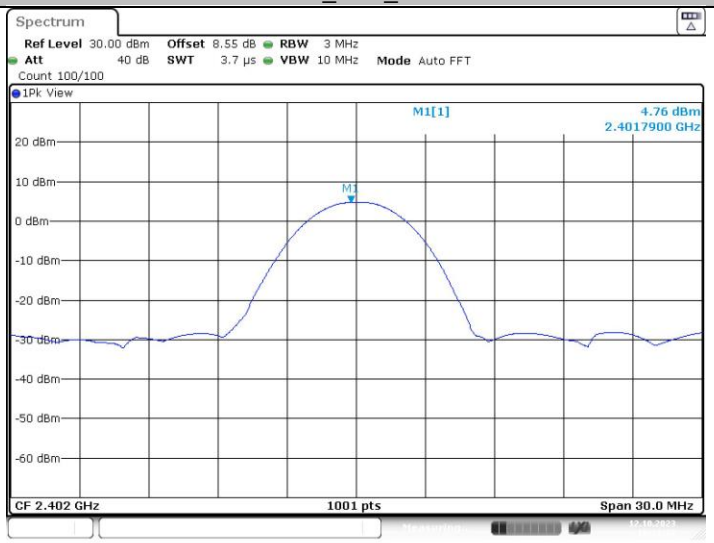
DH5_Ant1_2441



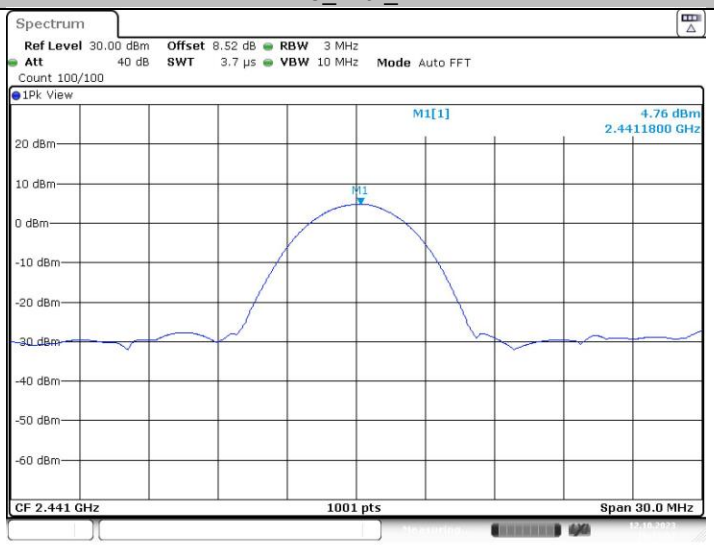
DH5_Ant1_2480



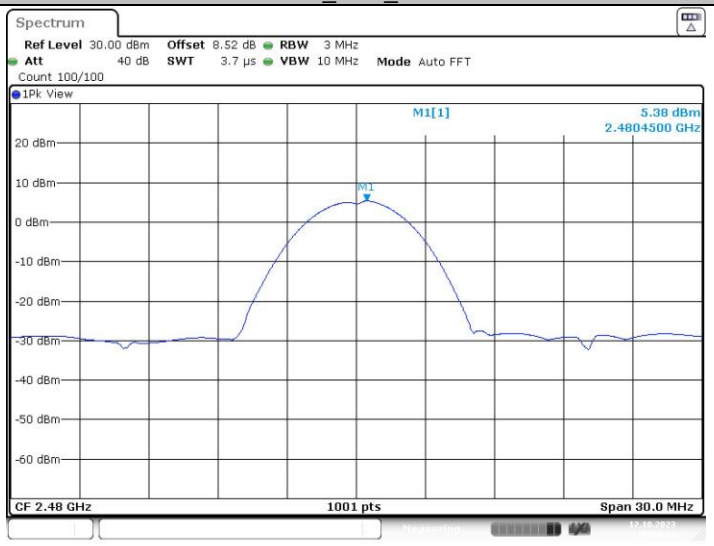
2DH5_Ant1_2402



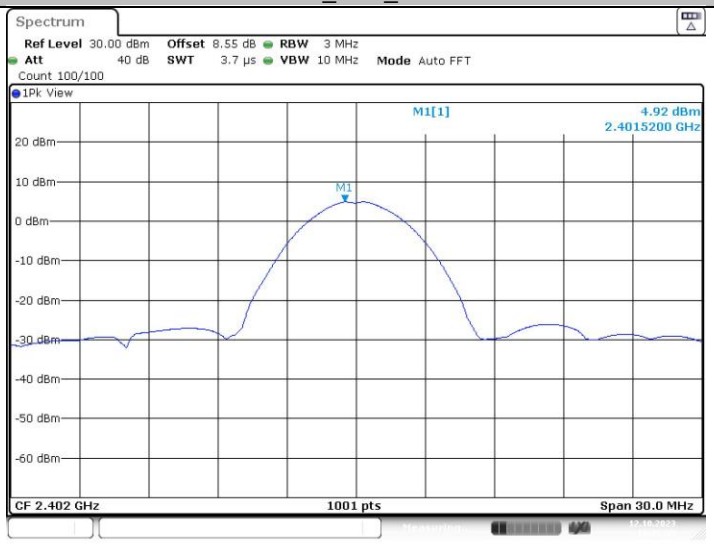
2DH5_Ant1_2441



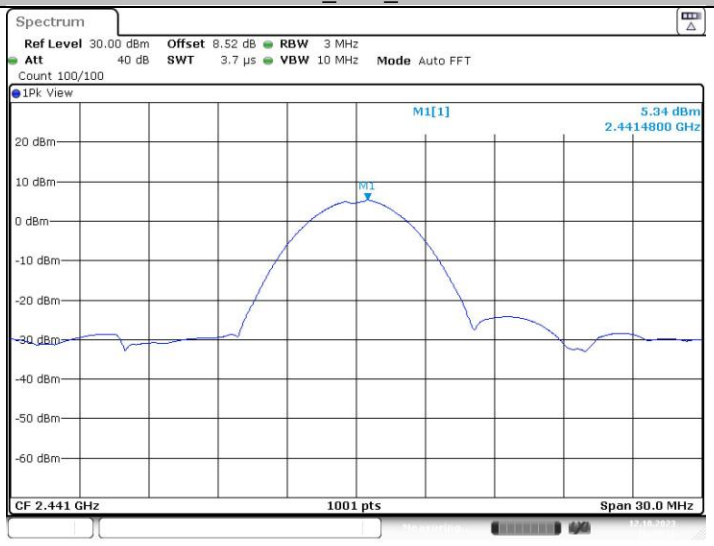
2DH5_Ant1_2480

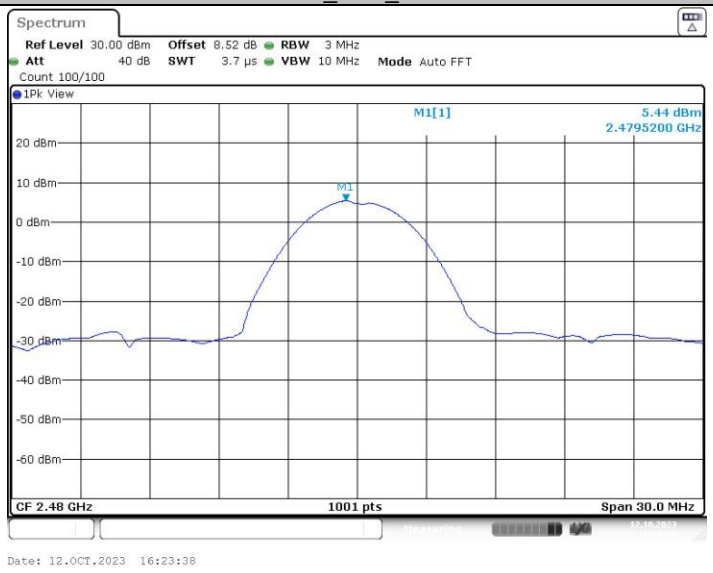


3DH5_Ant1_2402



3DH5_Ant1_2441



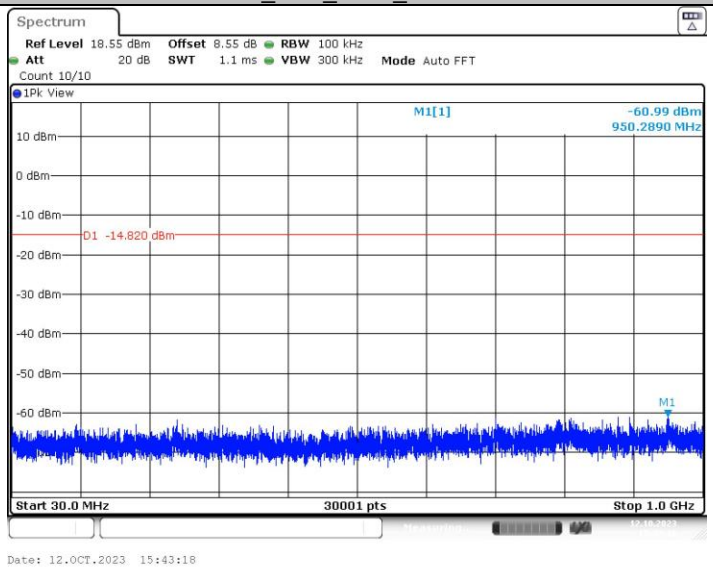
3DH5_Ant1_2480


APPENDIX J - CONDUCTED SPURIOUS EMISSION

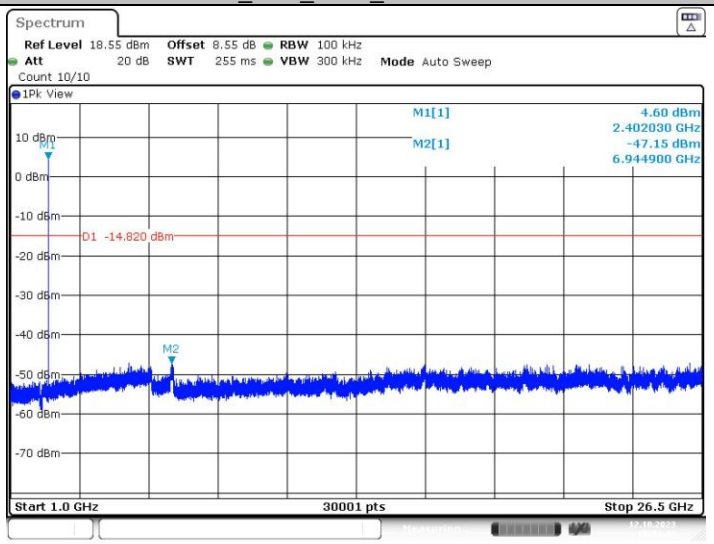
TestMode	Antenna	Freq(MHz)	FreqRange [MHz]	RefLevel [dBm]	Result [dBm]	Limit [dBm]	Verdict
DH5	Ant1	2402	30~1000	8.75	-59.14	≤-11.25	PASS
			1000~26500	8.75	-46.56	≤-11.25	PASS
		2441	30~1000	9.64	-60.39	≤-10.36	PASS
			1000~26500	9.64	-46.41	≤-10.36	PASS
		2480	30~1000	10.21	-59.88	≤-9.79	PASS
			1000~26500	10.21	-46.01	≤-9.79	PASS
2DH5	Ant1	2402	30~1000	6.06	-60.65	≤-13.94	PASS
			1000~26500	6.06	-45.81	≤-13.94	PASS
		2441	30~1000	6.83	-59.65	≤-13.17	PASS
			1000~26500	6.83	-46.67	≤-13.17	PASS
		2480	30~1000	6.68	-60.97	≤-13.32	PASS
			1000~26500	6.68	-45.72	≤-13.32	PASS
3DH5	Ant1	2402	30~1000	6.06	-59.47	≤-13.94	PASS
			1000~26500	6.06	-46.9	≤-13.94	PASS
		2441	30~1000	6.80	-59.37	≤-13.2	PASS
			1000~26500	6.80	-46.38	≤-13.2	PASS
		2480	30~1000	6.71	-60.25	≤-13.29	PASS
			1000~26500	6.71	-46.4	≤-13.29	PASS

Test Graphs

DH5_Ant1_2402_30~1000

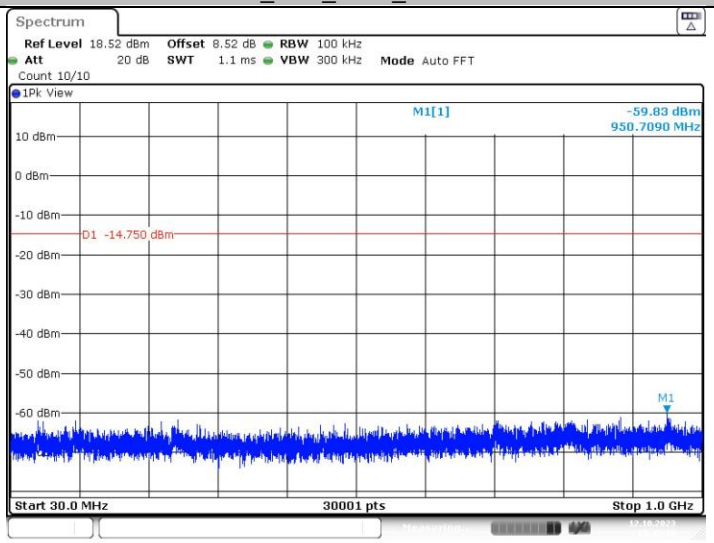


DH5_Ant1_2402_1000~26500



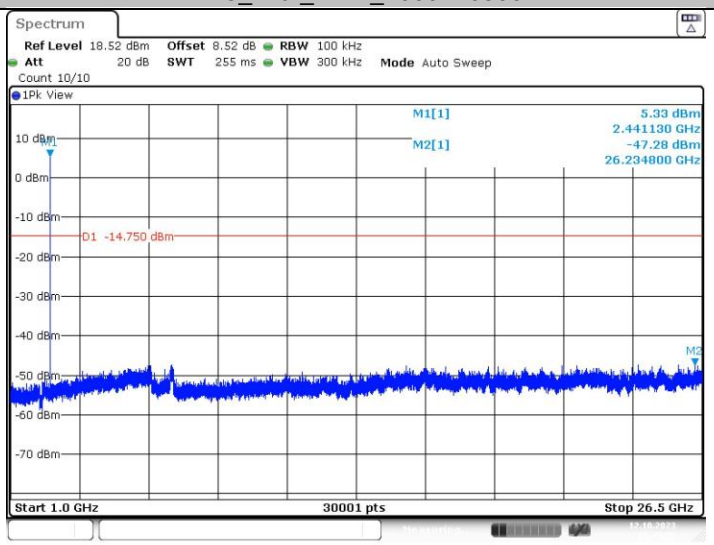
Date: 12.OCT.2023 15:43:43

DH5_Ant1_2441_30~1000



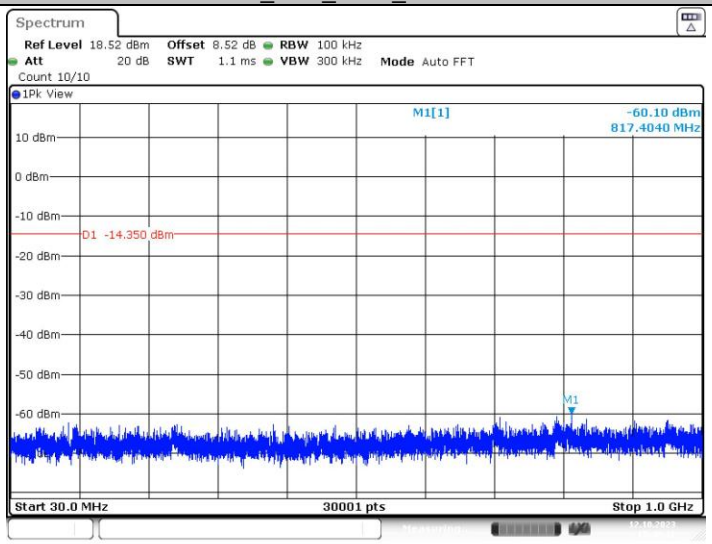
Date: 12.OCT.2023 15:45:10

DH5_Ant1_2441_1000~26500



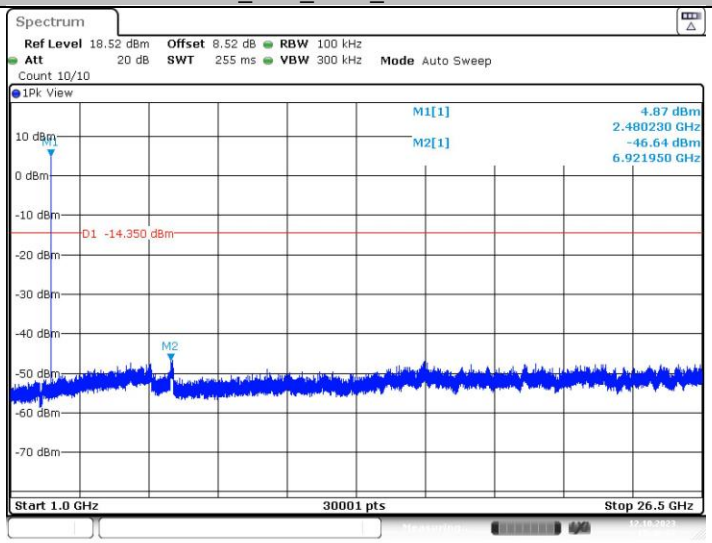
Date: 12.OCT.2023 15:45:35

DH5_Ant1_2480_30~1000



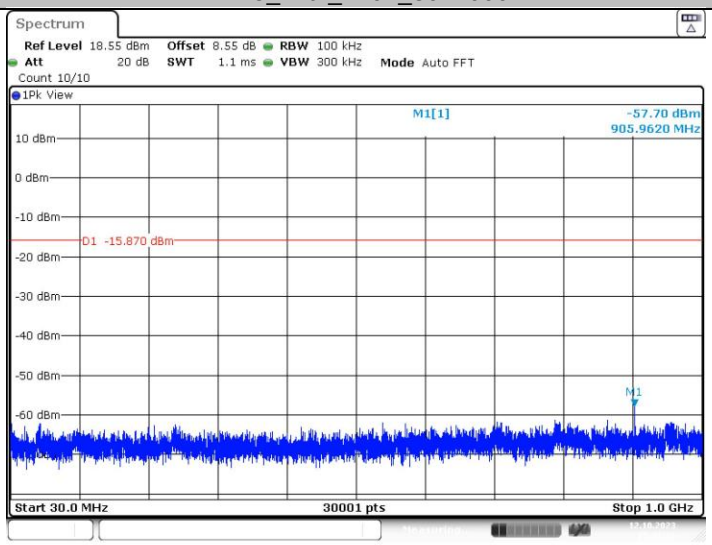
Date: 12.OCT.2023 15:48:12

DH5_Ant1_2480_1000~26500



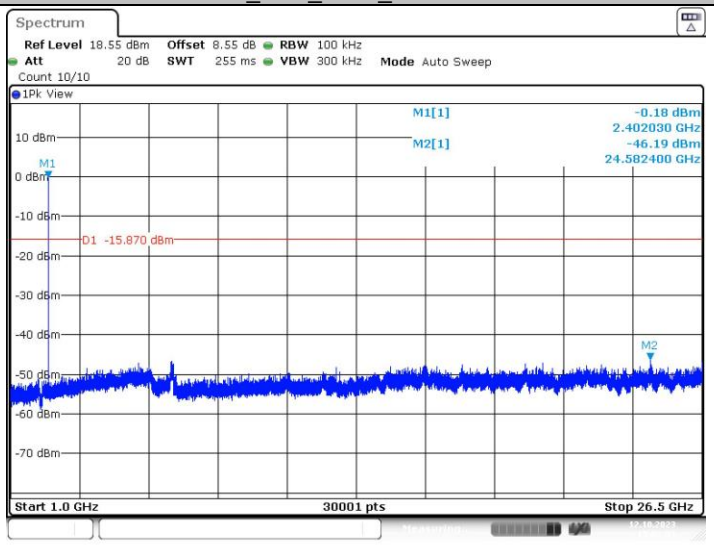
Date: 12.OCT.2023 15:48:37

2DH5_Ant1_2402_30~1000



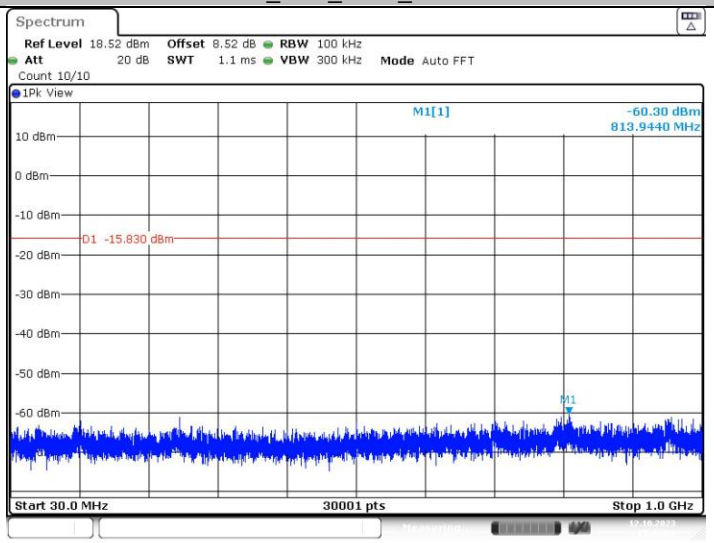
Date: 12.OCT.2023 15:51:28

2DH5_Ant1_2402_1000~26500



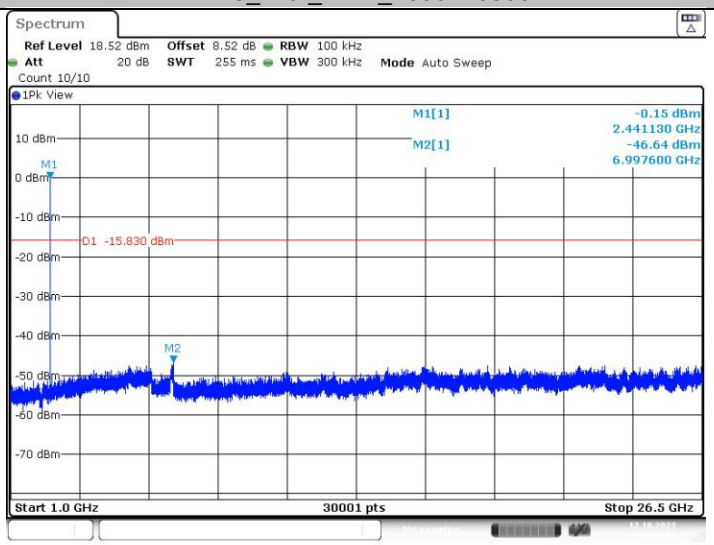
Date: 12.OCT.2023 15:51:53

2DH5_Ant1_2441_30~1000



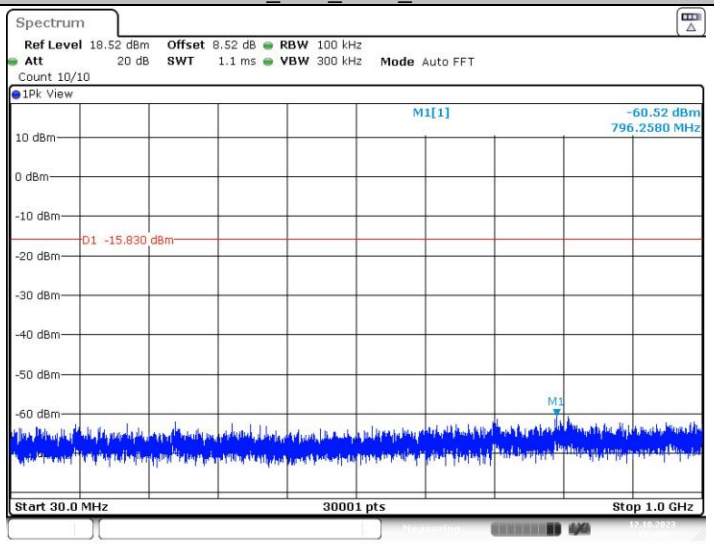
Date: 12.OCT.2023 15:53:06

2DH5_Ant1_2441_1000~26500



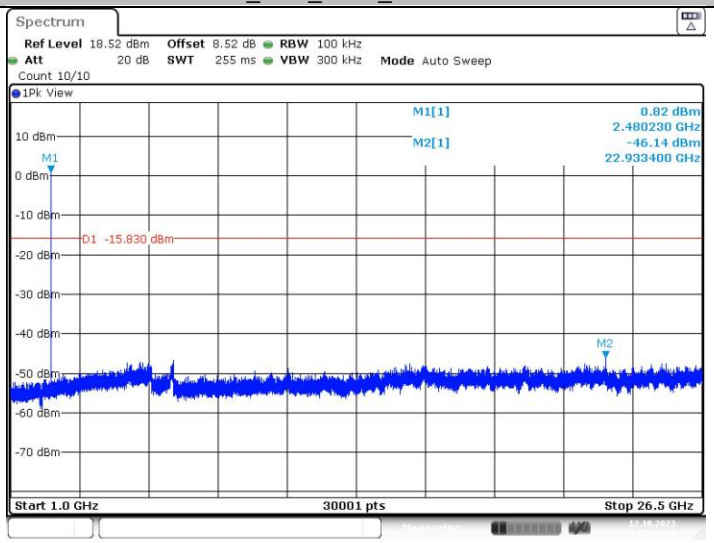
Date: 12.OCT.2023 15:53:31

2DH5_Ant1_2480_30~1000



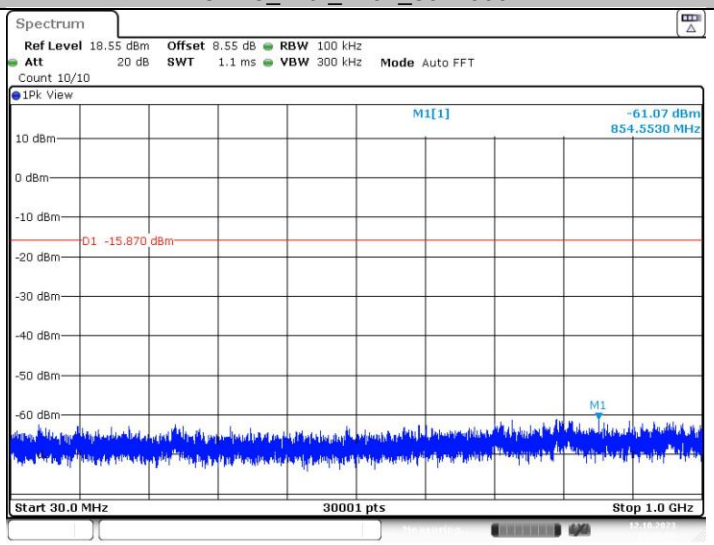
Date: 12.OCT.2023 15:55:51

2DH5_Ant1_2480_1000~26500



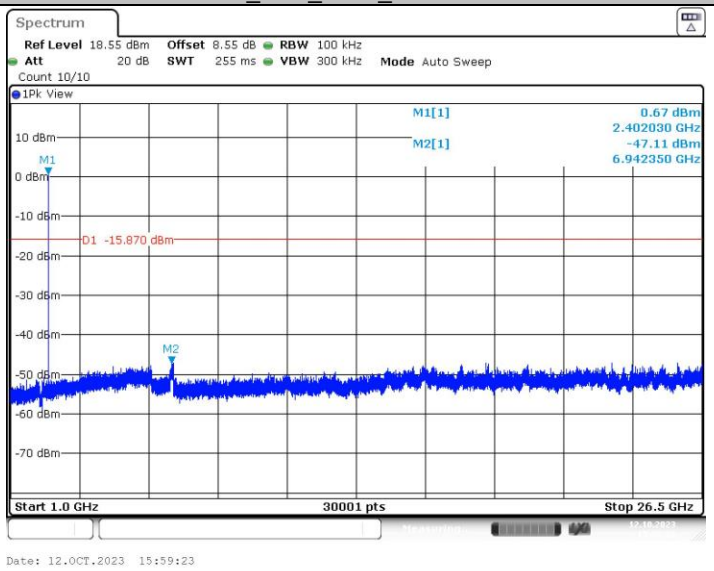
Date: 12.OCT.2023 15:56:16

3DH5_Ant1_2402_30~1000

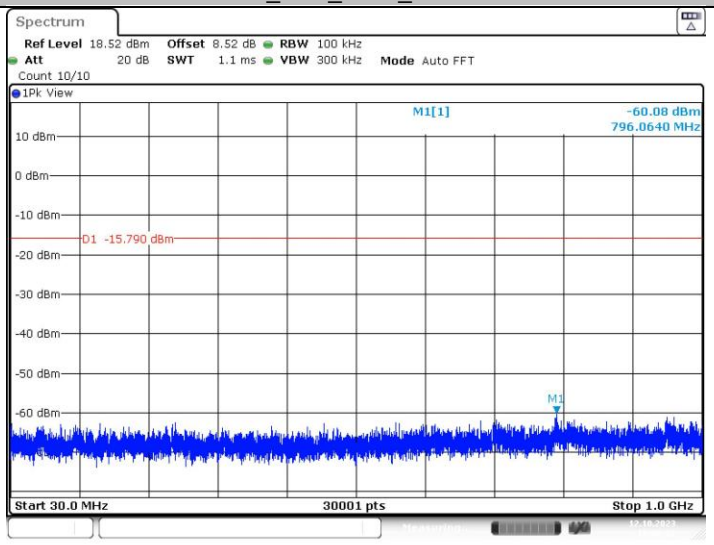


Date: 12.OCT.2023 15:58:58

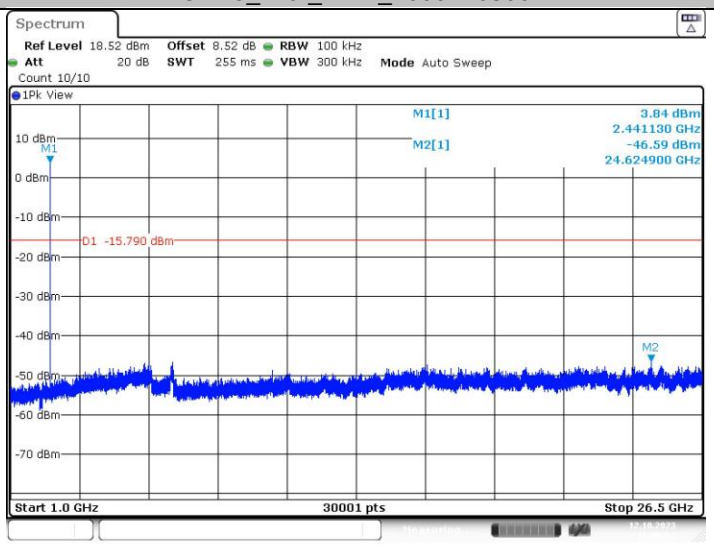
3DH5_Ant1_2402_1000~26500



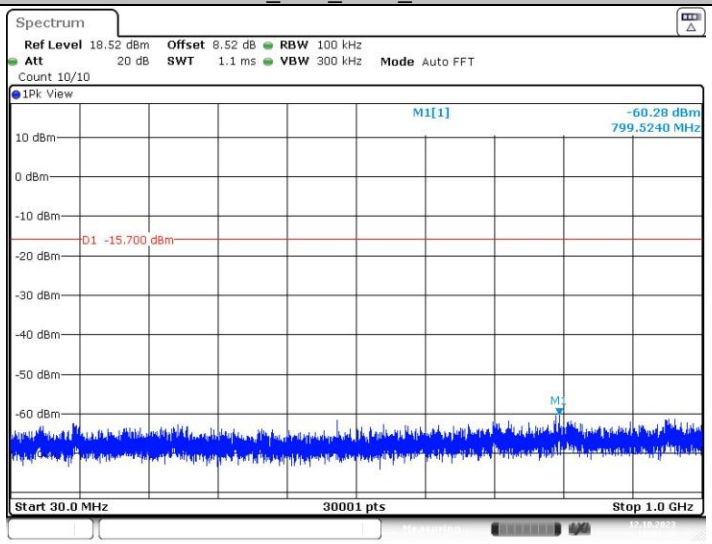
3DH5_Ant1_2441_30~1000



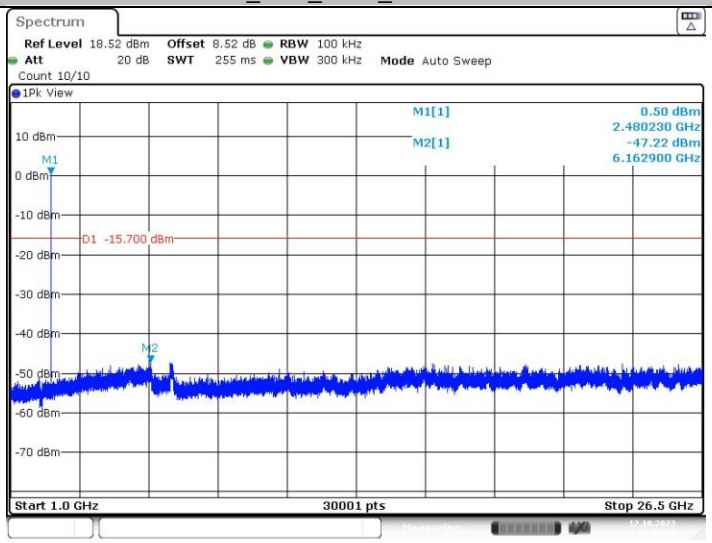
3DH5_Ant1_2441_1000~26500



3DH5_Ant1_2480_30~1000

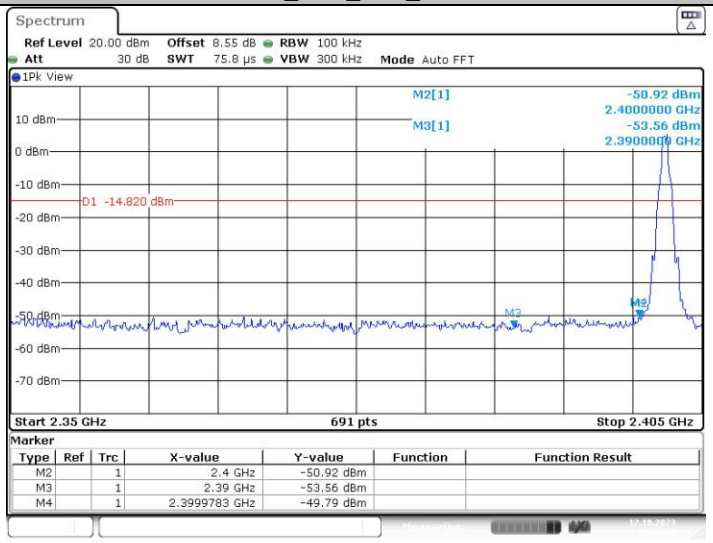


3DH5_Ant1_2480_1000~26500

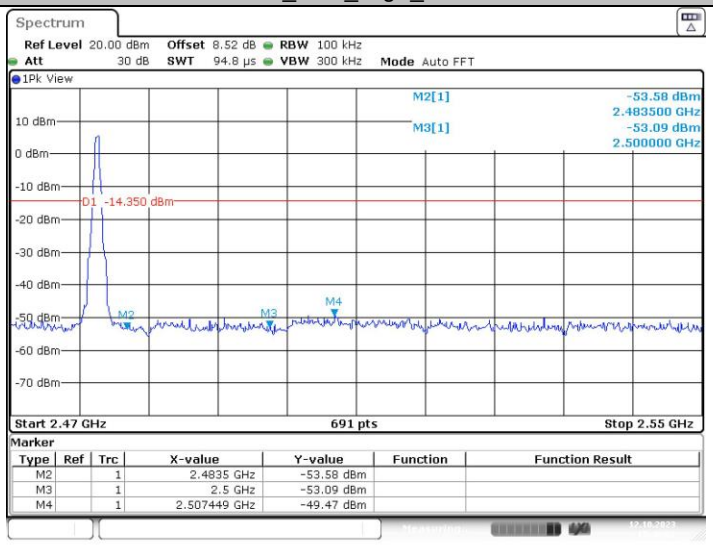


Band edge check

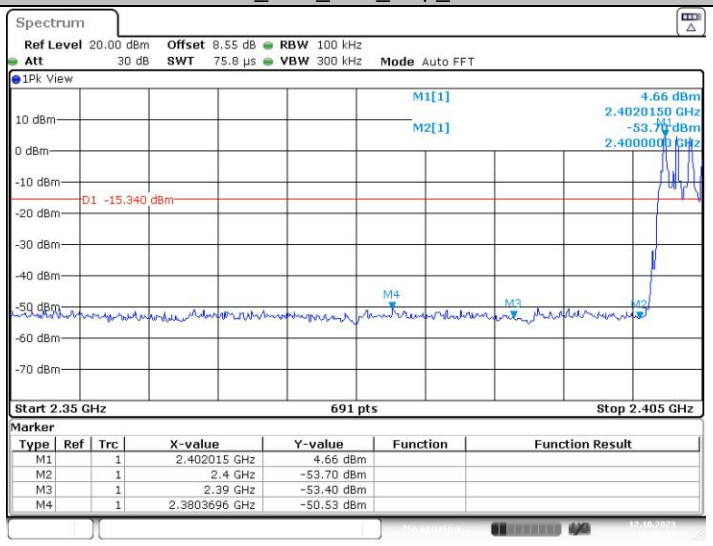
DH5_Ant1_Low_2402



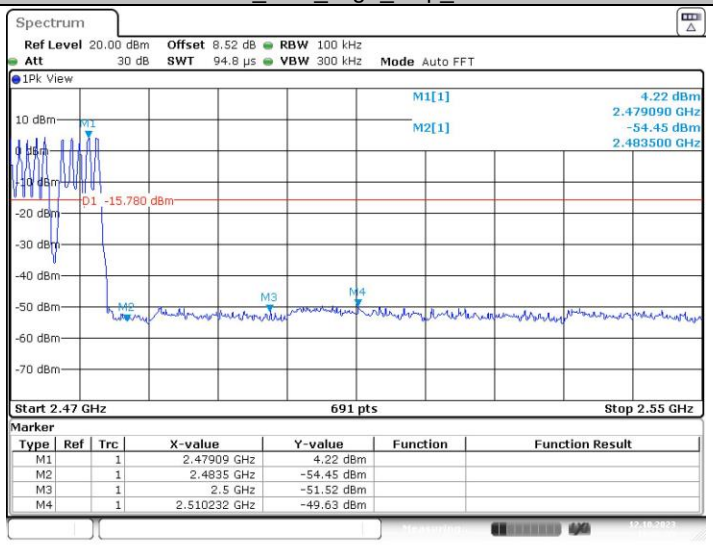
DH5_Ant1_High_2480



DH5_Ant1_Low_Hop_2402

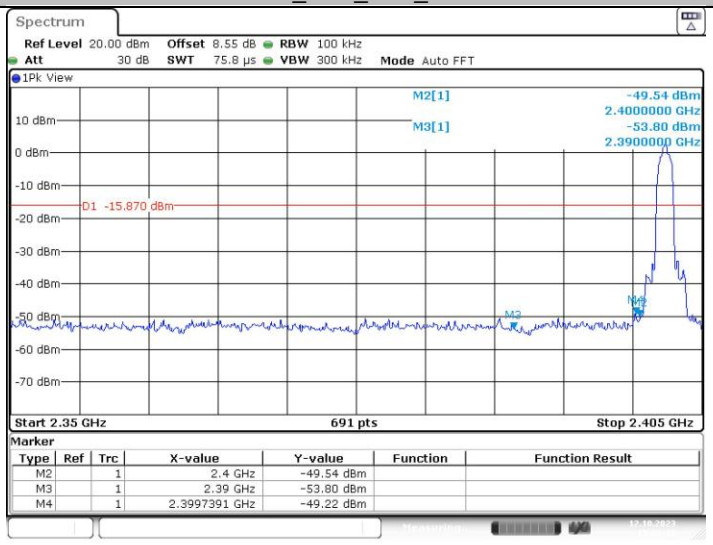


DH5_Ant1_High_Hop_2480



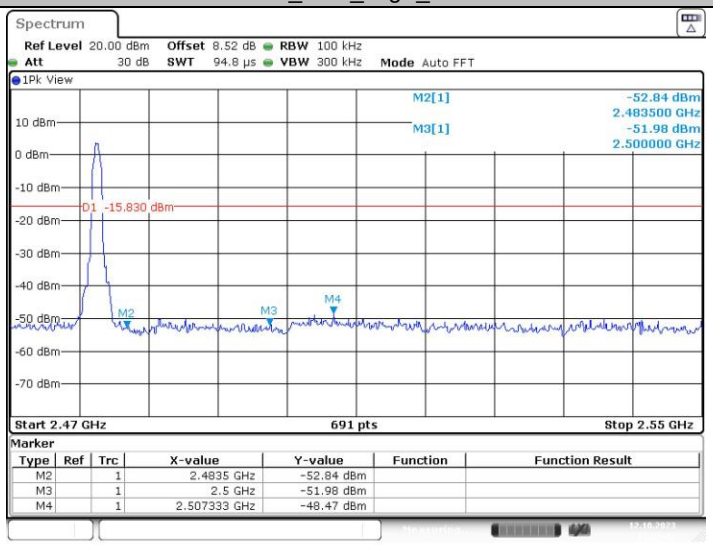
Date: 12.OCT.2023 16:09:54

2DH5_Ant1_Low_2402



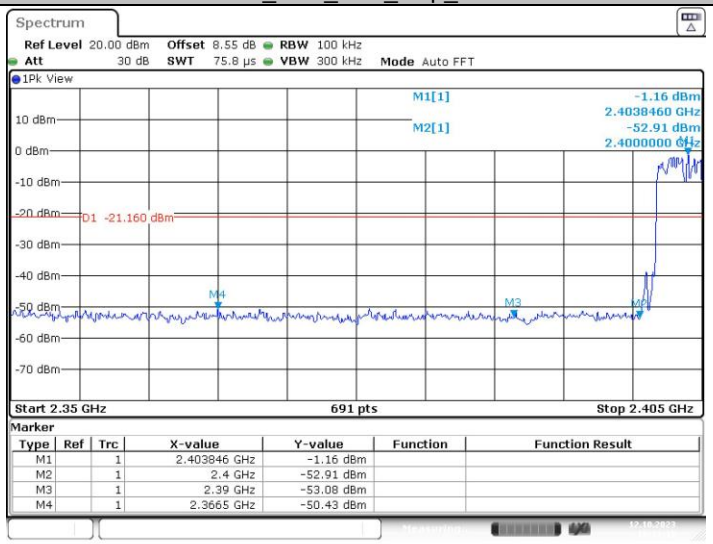
Date: 12.OCT.2023 15:51:19

2DH5_Ant1_High_2480

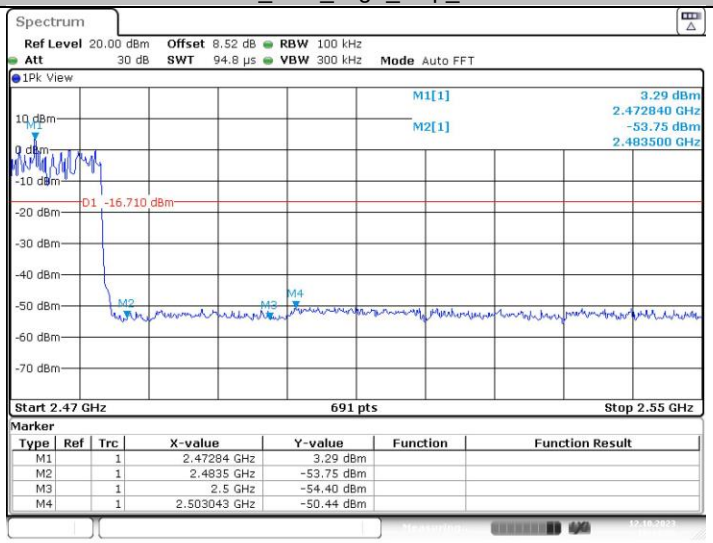


Date: 12.OCT.2023 15:55:41

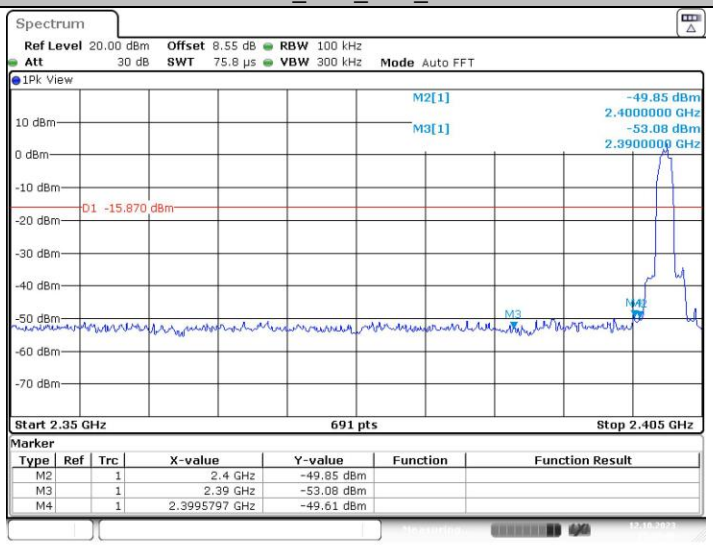
2DH5_Ant1_Low_Hop_2402



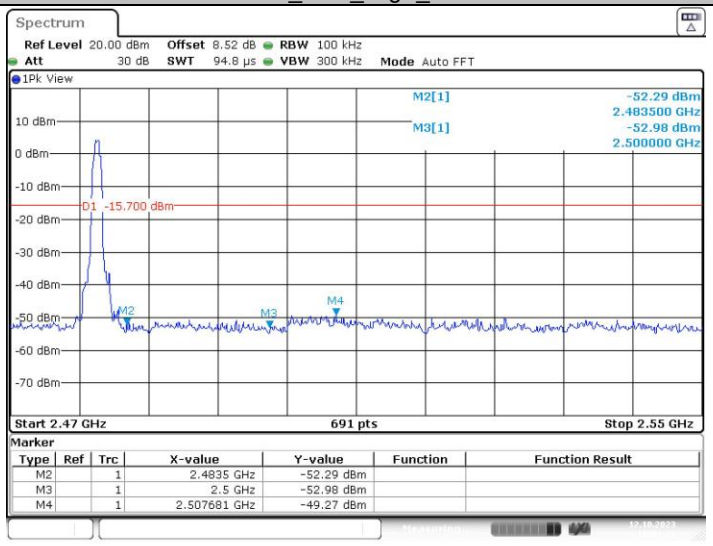
2DH5_Ant1_High_Hop_2480



3DH5_Ant1_Low_2402

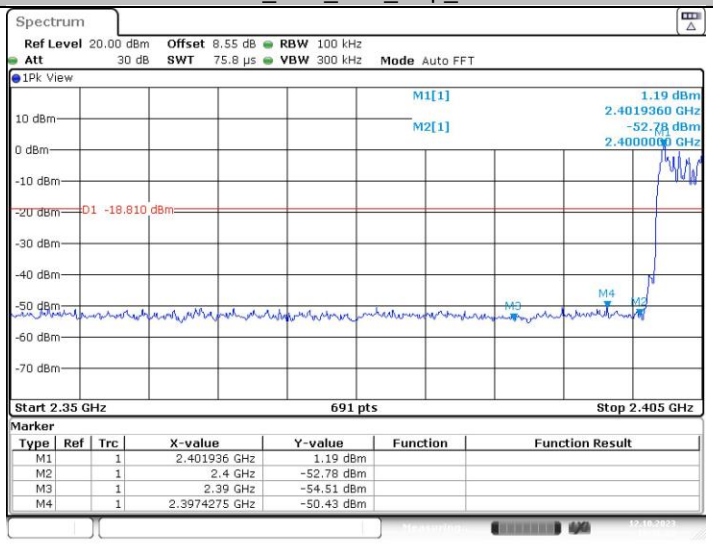


3DH5_Ant1_High_2480



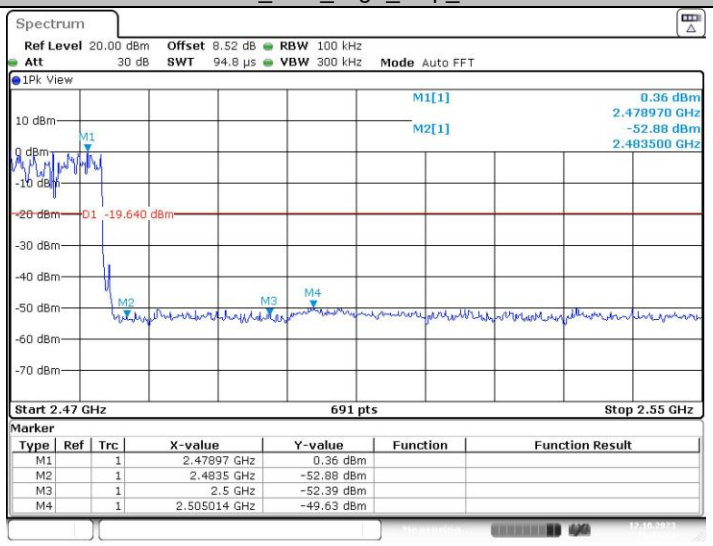
Date: 12.OCT.2023 16:03:20

3DH5_Ant1_Low_Hop_2402



Date: 12.OCT.2023 16:16:24

3DH5_Ant1_High_Hop_2480



Date: 12.OCT.2023 16:19:21

APPENDIX K - DECLARATION FOR BLUETOOTH DEVICE

1. Output power and channel separation of a Bluetooth device in the different operating modes:

The different operating modes (data-mode, acquisition-mode) of a Bluetooth device has no influence on the output power and the channel spacing. There is only one transmitter which is driven by identical input parameters concerning these two parameters.
Only a different hopping sequence will be used. For this reason the check of these RF parameters in one op-mode is sufficient.

2. Frequency range of a Bluetooth device:

Hereby we declare that the maximum frequency of this device is: 2402 - 2480MHz. This is according to the Bluetooth Core Specification (+ critical errata) for devices which will be operated in the USA.
This was checked during the Bluetooth Qualification tests (Test Case: TRM/CA/04-E). Other frequency ranges (e.g. for Spain, France, Japan) which are allowed according the Core Specification are not supported by this device.

3. Co-ordination of the hopping sequence in data mode to avoid simultaneous occupancy by multiple transmitters:

Bluetooth units which want to communicate with other units must be organised in a structure called piconet. This piconet consist of max. 8 Bluetooth units. One unit is the master the other seven are the slaves. The master co-ordinates frequency occupation in this piconet for all units. As the master hop sequence is derived from its BD address which is unique for each Bluetooth device, additional masters intending to establish new piconets will always use different hop sequences.

4. Example of a hopping sequence in data mode:

Example of a 79 hopping sequence in data mode:
40, 21, 44, 23, 42, 53, 46, 55, 48, 33, 52, 35, 50, 65, 54, 67, 56, 37, 60, 39, 58, 69, 62, 71, 64, 25, 68, 27, 66, 57, 70, 59, 72, 29, 76, 31, 74, 61, 78, 63, 01, 41, 05, 43, 03, 73, 07, 75, 09, 45, 13, 47, 11, 77, 15, 00, 64, 49, 66, 53, 68, 02, 70, 06, 01, 51, 03, 55, 05, 04

5. Equally average use of frequencies in data mode and behaviour for short transmissions:

The generation of the hopping sequence in connection mode depends essentially on two input values:
a) LAP/UAP of the master of the connection.
b) Internal master clock.

The LAP (lower address part) are the 24 LSB's of the 48 BD_ADDRESS. The BD_ADDRESS is an unambiguous number of every Bluetooth unit. The UAP (upper address part) are the 24 MSB's of the 48 BD_ADDRESS.

The internal clock of a Bluetooth unit is derived from a free running clock which is never adjusted and is never turned off. For synchronisation with other units only offset are used. It has no relation to the time of the day. Its resolution is at least half the RX/TX slot length of 312.5 µs. The clock has a cycle of about one day (23h30). In most case it is implemented as 28 bit counter. For the deriving of the hopping sequence the entire.
LAP (24 bits), 4 LSB's (4 bits) (Input 1) and the 27 MSB's of the clock (Input 2) are used. With this input values different mathematical procedures (permutations, additions, XOR- operations) are performed to generate the sequence. This will be done at the beginning of every new transmission.

Regarding short transmissions the Bluetooth system has the following behaviour:
The first connection between the two devices is established, a hopping sequence was generated. For transmitting the wanted data the complete hopping sequence was not used. The connection ended.
The second connection will be established. A new hopping sequence is generated. Due to the fact that the Bluetooth clock has a different value, because the period between the two transmission is longer (and it cannot be shorter) than the minimum resolution of the clock (312.5 µs). The hopping sequence will always differ from the first one.

6. Receiver input bandwidth and behaviour for repeated single or multiple packets:

The input bandwidth of the receiver is 1 MHz. In every connection one Bluetooth device is the master and the other one is the slave. The master determines the hopping sequence (see chapter 5). The slave follows this sequence. Both devices shift between RX and TX time slot according to the clock of the master.
Additionally the type of connection (e.g. single or multislot packet) is set up at the beginning of the connection. The master adapts its hopping frequency and its TX/RX timing according to the packet type of the connection. Also the slave of the connection will use these settings.
Repeating of a packet has no influence on the hopping sequence. The hopping sequence generated by the master of the connection will be followed in any case. That means, a repeated packet will not be send on the same frequency, it is send on the next frequency of the hopping sequence.

End of Test Report