

Prüfbericht-Nr.: <i>Test Report No.:</i>	50144050 001	Auftrags-Nr.: <i>Order No.:</i>	114076719	Seite 1 von 41 <i>Page 1 of 41</i>
Kunden-Referenz-Nr.: <i>Client Reference No.:</i>	N/A	Auftragsdatum: <i>Order date:</i>	13-April-2018	
Auftraggeber: <i>Client:</i>	Audeze LLC 3410 S Susan St., Santa Ana CA, USA, Zip Code: 92704			
Prüfgegenstand: <i>Test item:</i>	Immersive Cinematic 3D Audio Headphone			
Bezeichnung / Typ-Nr.: <i>Identification / Type No.:</i>	MOBIUS			
Auftrags-Inhalt: <i>Order content:</i>	NCC Test report (BDR/EDR)			
Prüfgrundlage: <i>Test specification:</i>	NCC Low-power Radio-frequency Devices Technical Regulations LP0002(2018) Section 3.10.1			
Wareneingangsdatum: <i>Date of receipt:</i>	22-April-2018			
Prüfmuster-Nr.: <i>Test sample No.:</i>	A000728303-006 Rad A000728303-005 Cond			
Prüfzeitraum: <i>Testing period:</i>	25-Apr-2018 – 02-May-2018			
Ort der Prüfung: <i>Place of testing:</i>	EMC/RF Laboratory Taipei			
Prüflaboratorium: <i>Testing laboratory:</i>	TUV Rheinland Taiwan Ltd.			
Prüfergebnis*: <i>Test result*:</i>	Pass			
geprüft von / tested by:		kontrolliert von / reviewed by:		
2018-05-18 Mars Y.J. Lin / Project Engineer <i>Datum</i> <i>Name / Stellung</i> <i>Unterschrift</i> <i>Date</i> <i>Name / Position</i> <i>Signature</i>		2018-05-21 Arvin Ho/Vice General Manager <i>Datum</i> <i>Name / Stellung</i> <i>Unterschrift</i> <i>Date</i> <i>Name / Position</i> <i>Signature</i>		
Sonstiges / Other: They are two chips of this MOBIUS, the chip is same, only the item number is different. They just put different marking for paying loyalty. Please refer the APPENDIX for detailed information.				
Zustand des Prüfgegenstandes bei Anlieferung: <i>Condition of the test item at delivery:</i>		Prüfmuster vollständig und unbeschädigt <i>Test item complete and undamaged</i>		
* Legende: 1 = sehr gut 2 = gut 3 = befriedigend 4 = ausreichend 5 = mangelhaft P(ass) = entspricht o.g. Prüfgrundlage(n) F(ail) = entspricht nicht o.g. Prüfgrundlage(n) N/A = nicht anwendbar N/T = nicht getestet Legend: 1 = very good 2 = good 3 = satisfactory 4 = sufficient 5 = poor P(ass) = passed a.m. test specification(s) F(ail) = failed a.m. test specification(s) N/A = not applicable N/T = not tested				
Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. <i>This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.</i>				

TEST SUMMARY

5.1.1 ANTENNA REQUIREMENT

RESULT: *Passed*

5.1.2 PEAK OUTPUT POWER

RESULT: *Passed*

5.1.3 20dB BANDWIDTH

RESULT: *Passed*

5.1.4 CONDUCTED SPURIOUS EMISSIONS AND FREQUENCY BAND EDGE MEASURED IN 100kHz BANDWIDTH

RESULT: *Passed*

5.1.5 SPURIOUS EMISSION

RESULT: *Passed*

5.1.6 FREQUENCY SEPARATION

RESULT: *Passed*

5.1.7 NUMBER OF HOPPING FREQUENCY

RESULT: *Passed*

5.1.8 TIME OF OCCUPANCY

RESULT: *Passed*

5.2.1 MAINS CONDUCTED EMISSIONS

RESULT: *Passed*

Contents

1.	GENERAL REMARKS	5
1.1	COMPLEMENTARY MATERIALS.....	5
2.	TEST SITES	6
2.1	TEST LABORATORY	6
2.2	TEST FACILITY.....	6
2.3	LIST OF TEST AND MEASUREMENT INSTRUMENTS.....	7
2.4	TRACEABILITY	8
2.5	CALIBRATION	8
2.6	MEASUREMENT UNCERTAINTY	8
3.	GENERAL PRODUCT INFORMATION.....	9
3.1	PRODUCT FUNCTION AND INTENDED USE	9
3.2	SYSTEM DETAILS AND RATINGS.....	9
3.3	INDEPENDENT OPERATION MODES.....	11
3.4	NOISE GENERATING AND NOISE SUPPRESSING PARTS	11
3.5	SUBMITTED DOCUMENTS.....	11
4.	TEST SET-UP AND OPERATION MODES.....	12
4.1	PRINCIPLE OF CONFIGURATION SELECTION	12
4.2	TEST OPERATION AND TEST SOFTWARE.....	12
4.3	SPECIAL ACCESSORIES AND AUXILIARY EQUIPMENT	12
4.4	COUNTERMEASURES TO ACHIEVE EMC COMPLIANCE.....	13
4.5	TEST SETUP DIAGRAM	13
5.	TEST RESULTS	15
5.1	TRANSMITTER REQUIREMENT & TEST SUITES.....	15
5.1.1	<i>Antenna Requirement</i>	<i>15</i>
5.1.2	<i>Peak Output Power</i>	<i>16</i>
5.1.3	<i>20dB Bandwidth</i>	<i>17</i>
5.1.4	<i>Conducted spurious emissions and Frequency Band Edge measured in 100kHz Bandwidth.....</i>	<i>21</i>
5.1.5	<i>Spurious Emission</i>	<i>29</i>
5.1.6	<i>Frequency Separation.....</i>	<i>30</i>
5.1.7	<i>Number of hopping frequency.....</i>	<i>32</i>
5.1.8	<i>Time of Occupancy</i>	<i>35</i>
5.2	MAINS EMISSIONS.....	37
5.2.1	<i>Mains Conducted Emissions.....</i>	<i>37</i>
6.	PHOTOGRAPHS OF THE TEST SET-UP.....	38

7.	LIST OF TABLES	41
8.	LIST OF PHOTOGRAPHS.....	41

1. General Remarks

1.1 Complementary Materials

The following attachments are integral parts of this test report:

Appendix P: Photo Documentation
(File Name: 50144050APPENDIX P)

Appendix D: Test Result of Radiated Emissions
(File Name: 50144050APPENDIX D)

Test Specifications

The following standards were applied

Table 1: Applied Standard and Test Levels

Radio
NCC Low-power Radio-frequency Devices Technical Regulations LP0002(2018)(107 年 1 月 10 日)

2. Test Sites

2.1 Test Laboratory

TUV Rheinland Taiwan Ltd.
Taichung Branch Office

No.9, Lane 36, Minsheng Rd., Sec. 3, Daya District,
Taichung City 428
Taiwan (R.O.C.)

2.2 Test Facility

TUV Rheinland Taiwan Ltd.
Taipei Office

11F. No.758, Sec. 4, Bade Rd., Songshan Dist.
Taipei City 105
Taiwan (R.O.C.)

FCC RegistrationNo.: 340738
IC Canada Registration No.: 9465A-1
TAF Accredited NCC Test Lab. No.:0759
TAF ISO17025 Certification effective periods: 2016-Jul-1st to 2019-Jun-30th



Testing Laboratory
0759

2.3 List of Test and Measurement Instruments

Table 2: List of Test and Measurement Equipment

Kind of Equipment	Manu-facturer	Type	S/N	Last Calibration	Next Calibration
Test Software	Farad	EZ_EMC	Ver. TUV3A1	N/A	N/A
EMI Test Receiver	R&S	ESR 7	101549	2017/11/10	2018/11/10
Spectrum Analyzer	R&S	FSV 40	100921	2018/05/02	2019/05/01
Spectrum Analyzer	Agilent	N9010A	MY53470241	2018/05/23	2019/05/22
Preamplifier (30MHz -1GHz)	HP	8447F	2805A03335	2017/08/14	2018/08/14
Preamplifier (18 GHz -40 GHz)	COM-POWER	PAM-840	461257	2018/01/18	2019/01/18
Pre-Amplifier (1GHz~18GHz)	EM Electronics	EM01G18G	60558	2017/11/21	2018/11/21
Bilog Antenna	TESEQ	CBL6111D	29804	2017/08/18	2018/08/18
Horn Antenna	ETS-Lindgren	3117	201918	2017/08/18	2018/08/18
Horn Antenna (18GHz~40GHz)	COM-POWER	AH-840	101029	2017/11/28	2018/11/28
Loop Antenna	Schwarzbeck	FMZB 1513	1513-076	2017/06/14	2018/06/14
EMI Test Receiver	R&S	ESR 7	101549	2017/11/10	2018/11/10
Spectrum Analyzer	R&S	FSL3	101943	2015/09/07	2018/09/07
Temp. & Humid. Chamber	Giant Force	GCT-099-40-S	MAF0103-007	2017/03/09	2019/03/09
LISN (1 phase)	R&S	ENV216	101243	2017/06/18	2018/06/18
LISN	R&S	ENV216	101262	2017/06/22	2018/06/21

2.4 Traceability

All measurement equipment calibrations are traceable to NML(Taiwan)/NIST(USA) or where calibration is performed outside Taiwan, to equivalent nationally recognized standards organizations.

2.5 Calibration

Equipment requiring calibration is calibrated periodically in a suitably accredited Calibration Lab. Additionally all equipment is verified for proper performance on a regular basis using in house standards or comparisons.

2.6 Measurement Uncertainty

The estimated combined standard uncertainty for radiated emissions and conducted emissions measurements.

Table 3: Emission Measurement Uncertainty

Parameter	Uncertainty
Radio Frequency	± 0.1 ppm
RF power, conducted	± 1.5 dB
Adjacent channel power	± 3 dB
Radiated emission of transmitter, valid up to 26 GHz	± 6 dB
Radiated emission of receiver, valid up to 26 GHz	± 6 dB
Temperature	± 2 °C
Humidity	± 10 %

3. General Product Information

3.1 Product Function and Intended Use

The EUT is a Bluetooth Headphone. It contains a Bluetooth 4.2 compatible module enabling the user to communicate data through a Wireless interface.
For details refer to the User Guide, Data Sheet and Circuit Diagram.

3.2 System Details and Ratings

Table 4: Basic Information of EUT

Item	EUT information
Kind of Equipment/Test Item	Immersive Cinematic 3D Audio Headphone
Type Identification	MOBIUS
Brand Name	Audeze

Table 5: Technical Specification of EUT

Technical Specification	Value
Operating Frequency	2402 MHz ~ 2480 MHz
Channel Spacing	1 MHz
Channel number	79
Operation Voltage	5Vdc
Modulation	GFSK, $\pi/4$ DQPSK, 8DPSK
Antenna gain	2.459dBi

Table 6: Frequency hopping information

Technical Specification	Description
Hopping Range	Hereby we declare that the maximum frequency of this device is: 2402-2480MHz. This is according the Bluetooth Core Specification V2.1+EDR for devices which will be operated in the USA. This was checked during the Bluetooth Qualification tests (Test Case: TRM/CA/04).
Hopping Sequence	Example of a 79 hopping sequence in data mode: 33,04,21,44,23,42,53,46,55,48,40,59,72,29,76,31,08,73,07,75,09,45,60,39,58,13,47,11,77,52,35,50,65,54,67,56,69,62,71,64, 7,25,27,66,57,70,74,61,78,63,10,41,05,43,15,44,64,68,02,70,06,01,51,03,55,05,03,66,53,49,36,47,
Receiver input bandwidth	The input bandwidth of the receiver is 1MHz. In every connection one Bluetooth device is the master and the other one is the slave. The master determines the hopping sequence. 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 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 packer 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.

3.3 Independent Operation Modes

The basic operation modes are:

- A. Transmitting
 - 1. Low channel
 - 2. Middle channel
 - 3. High channel
- B. Receiving
 - 1. Low channel
 - 2. Middle channel
 - 3. High channel
- C. Hopping

3.4 Noise Generating and Noise Suppressing Parts

Refer to the Circuit Diagram.

3.5 Submitted Documents

- Circuit Diagram
- Instruction Manual
- Rating Label
- Technical Description

4. Test Set-up and Operation Modes

4.1 Principle of Configuration Selection

The equipment under test (EUT) was configured to measure its maximum power level. The test modes were adapted accordingly in reference to the instructions for use.

4.2 Test Operation and Test Software

Setup for testing: Test samples are provided with a USB interface which makes it possible to control them through a test software installed on a notebook computer.

This software, Bluetooth RF test tool ISRT-5145 provided by manufacturer was running on the laptop computer connected to the EUT. It was used to enable the operation modes listed in section 3.3 as appropriate.

The samples were used as follows:
Conducted: **A000728303-005** Cond
Radiation: **A000728303-006** Rad

Full test was applied on all test modes, but only worst case was shown.

4.3 Special Accessories and Auxiliary Equipment

The product has been tested together with the following additional accessories:

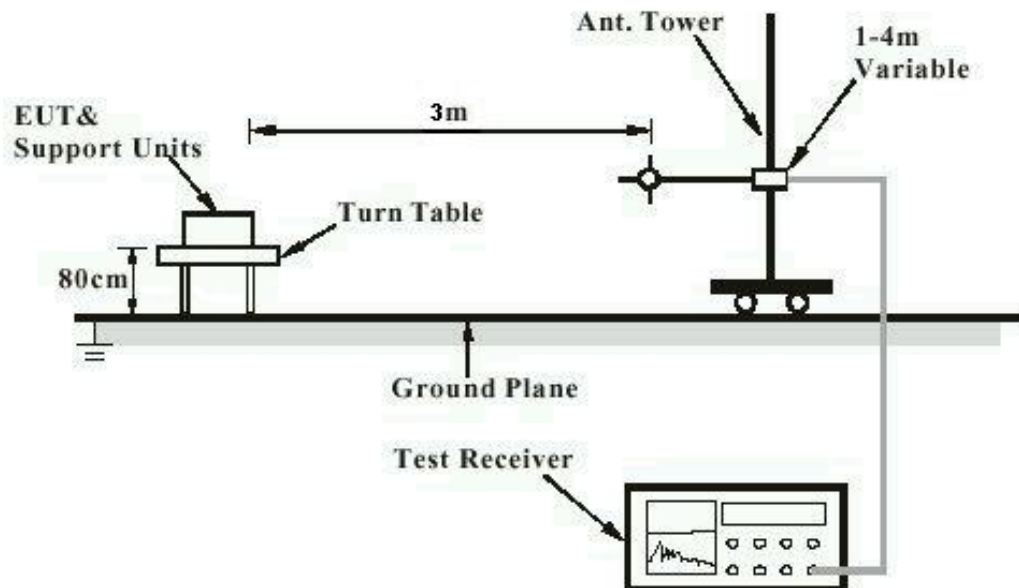
Kind of Equipment	Manufacturer	Model Name	Serial No.
Notebook(EMC-06)	Lenovo	TP00048A	PB-0F8B2

4.4 Countermeasures to achieve EMC Compliance

The test sample which has been tested containing the noise suppression parts as in the Photo Appendix and the Test Setup Photos. No additional measures were employed to achieve compliance.

4.5 Test Setup Diagram

Diagram of Measurement Configuration for Radiation Test



Note: Measurements above 1 GHz are done with a table height of 1.5m

Diagram of Measurement Equipment Configuration for Mains Conduction Measurement

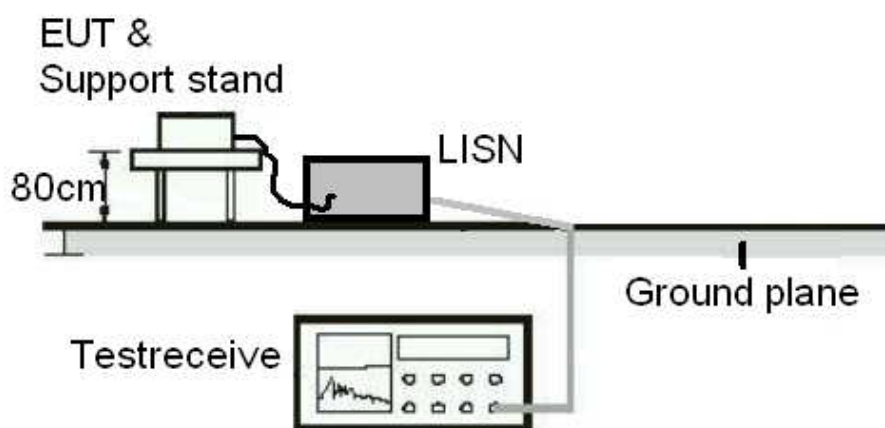
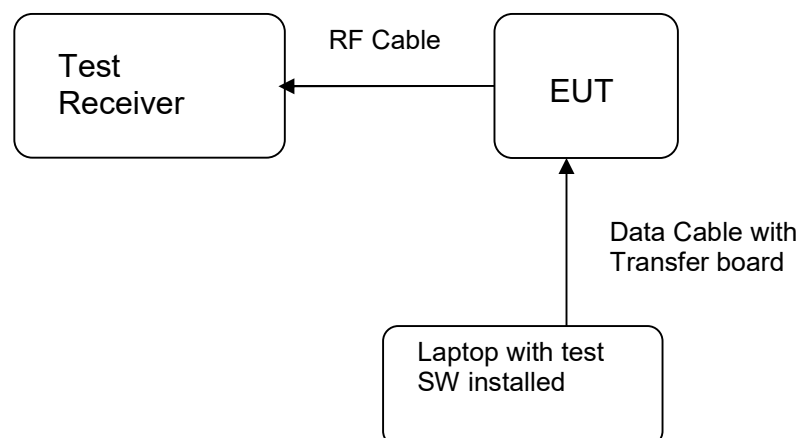


Diagram of Measurement Equipment Configuration for Conducted Transmitter Measurement



5. Test Results

5.1 Transmitter Requirement & Test Suites

5.1.1 Antenna Requirement

RESULT:**Passed**

Test standard : LP0002(2018): 2.2, 3.10.1.3, 3.10.1.4

Requirement : use of approved antennas only with directional gains that do not exceed 6 dBi

According to the manufacturer declaration, the EUT has an antenna with a directional gain of 2.459 dBi. The antenna is a printed PCB trace with no possibility of replacement with a non-approved antenna by the end-user. Therefore, the EUT is considered to comply with this provision.

Refer to EUT photo for details.

5.1.2 Peak Output Power

RESULT:

Passed

Test standard : LP0002(2018): 3.10.1.2 (1)(B)
 Basic standard : LP0002(2018) Appendix II
 Kind of test site : Shielded room

Test setup

Test Channel : Low/ Middle/ High
 Operation Mode : A

Ambient temperature : 22-26 °C
 Relative humidity : 50-65 %
 Atmospheric pressure : 100-103 kPa

Table 7: Test result of Peak Output Power, GFSK modulation

Channel	Channel Frequency	Peak Output Power		Limit
	(MHz)	(dBm)	(W)	(W)
Low Channel	2402	4.76	0.00299	0.125
Middle Channel	2441	4.58	0.00287	0.125
High Channel	2480	4.44	0.00278	0.125

Table 8: Test result of Peak Output Power, 8DPSK modulation

Channel	Channel Frequency	Peak Output Power		Limit
	(MHz)	(dBm)	(W)	(W)
Low Channel	2402	5.27	0.00337	0.125
Middle Channel	2441	5.14	0.00327	0.125
High Channel	2480	5.03	0.00318	0.125

Pmax: **3.3651mW**

5.1.3 20dB Bandwidth

RESULT:
Passed

Test standard : LP0002(2018): 3.10.1.6 (1)(A)
 Basic standard : LP0002(2018) Appendix II

Test setup

Test Channel : Low/ Middle/ High
 Operation Mode : A
 Ambient temperature : 22-26°C
 Relative humidity : 50-65%
 Atmospheric pressure : 100-103kPa

Table 9: Test result of 20dB Bandwidth, GFSK modulation

Channel	Channel Frequency (MHz)	20dB Bandwidth (kHz)	Limit (MHz)	Result
Low Channel	2402	937.8	1.5	Pass
Mid Channel	2441	937.8	1.5	Pass
High Channel	2480	933.4	1.5	Pass

Note: Limit is for Channel Separation of 1 MHz and a power limit of 125 mW.

Table 10: Test result of 20dB Bandwidth, 8DPSK modulation

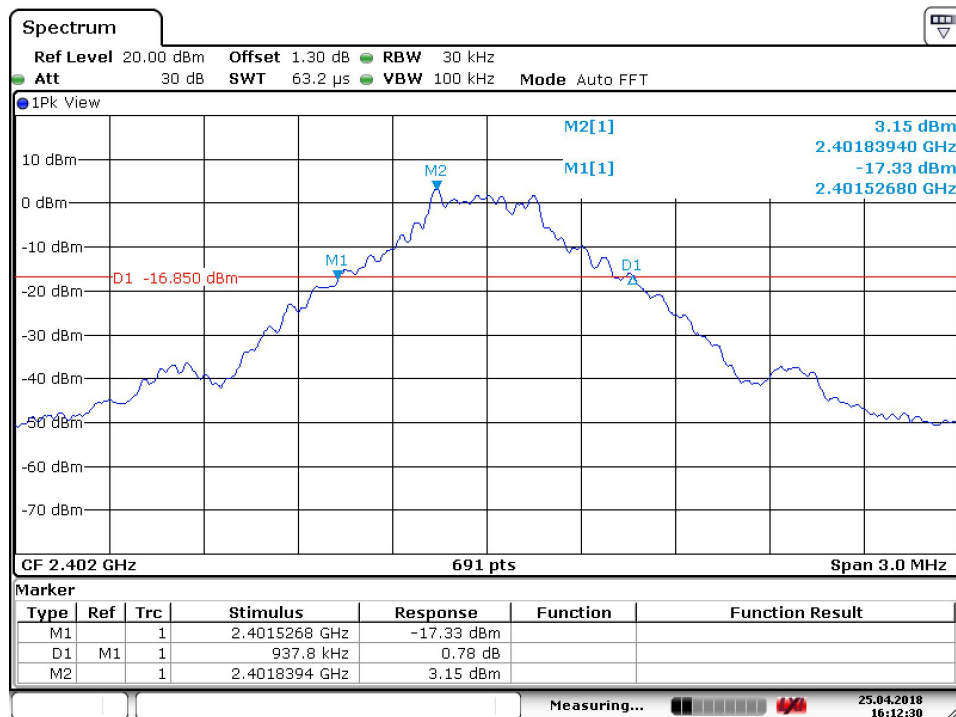
Channel	Channel Frequency (MHz)	20dB Bandwidth (kHz)	Limit (MHz)	Result
Low Channel	2402	1267.7	1.5	Pass
Mid Channel	2441	1259	1.5	Pass
High Channel	2480	1263.4	1.5	Pass

Note: Limit is for Channel Separation of 1 MHz and a power limit of 125 mW.

If the carrier separation frequency of a Bluetooth Device is set at 1 MHz due to the firmware setting and the Bluetooth Standard, then for power <125 mW the limit for the 20 dB Bandwidth, becomes 1 MHz / 0.66666 = 1.5 MHz.

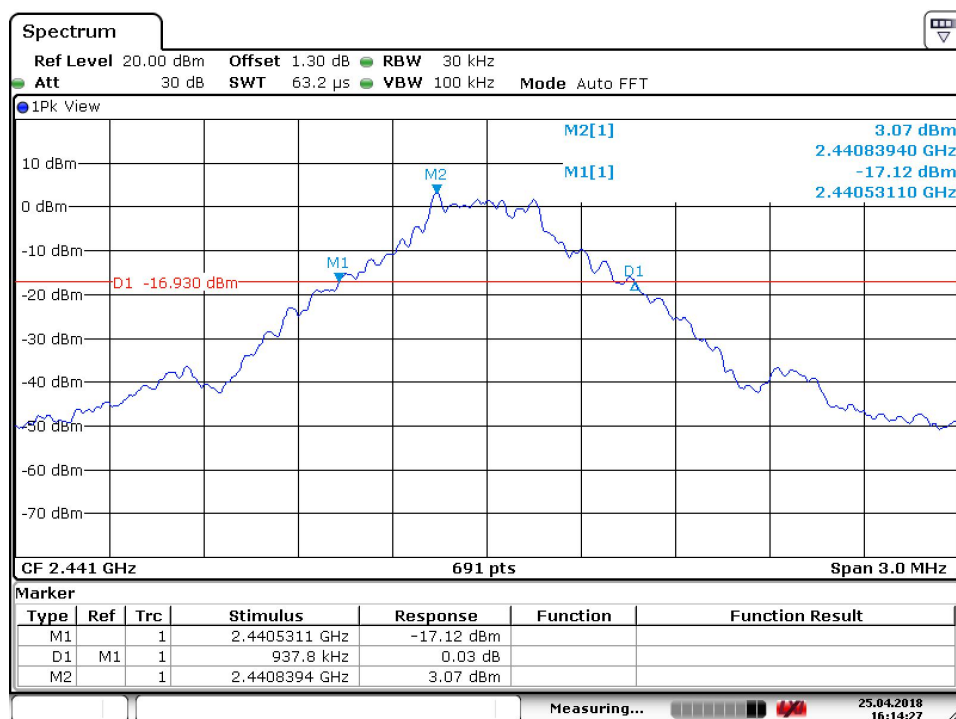
Test Plot of 20dB Bandwidth, GFSK modulation

Low Channel

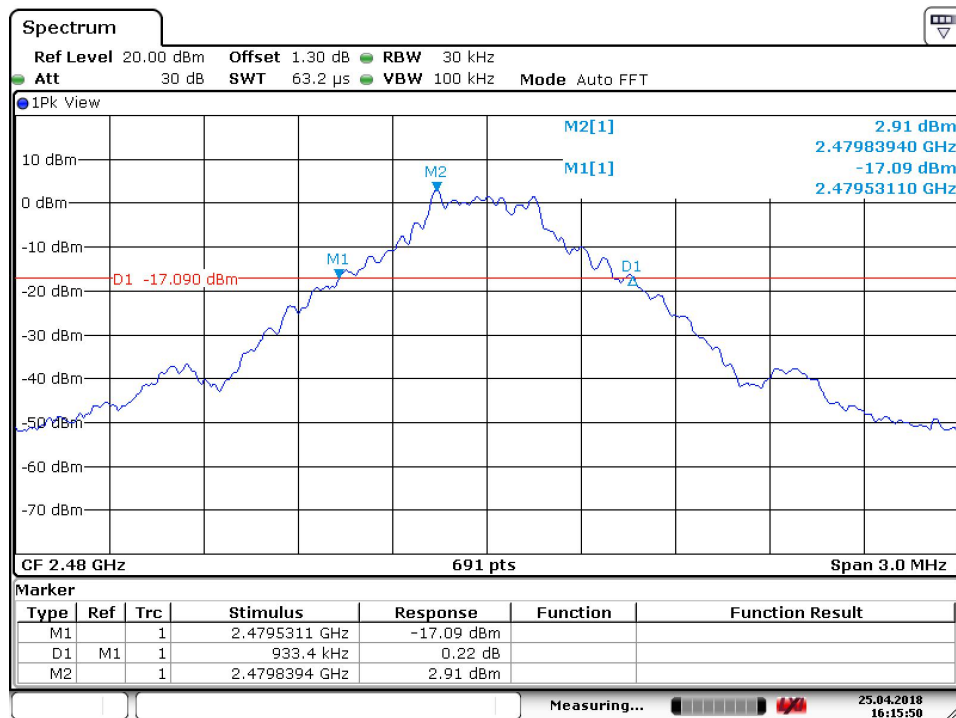


Date: 25.APR.2018 16:12:30

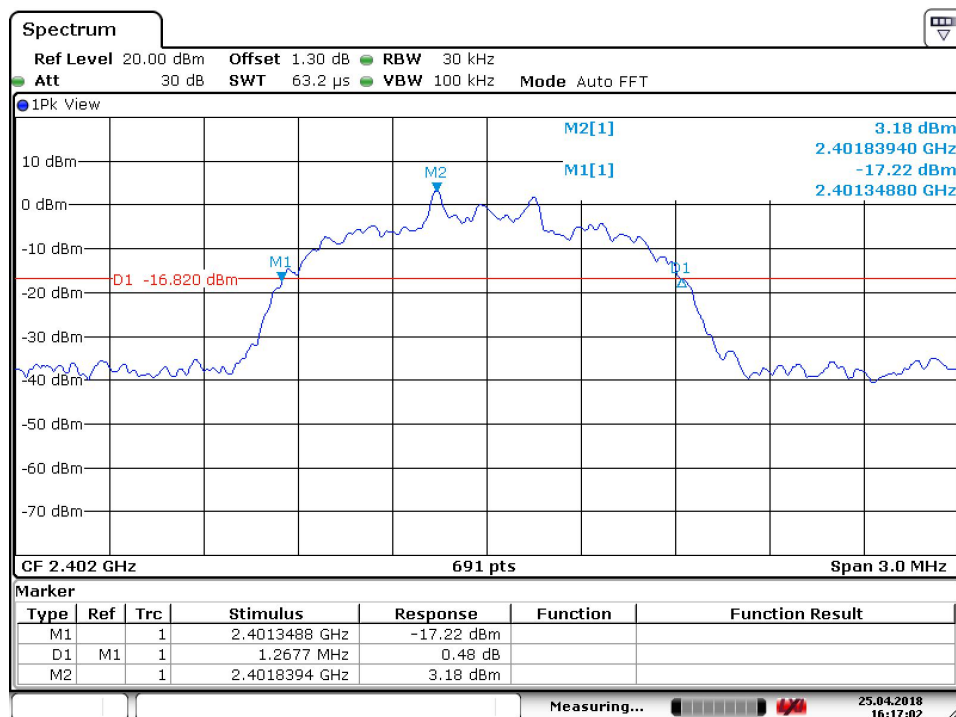
Middle Channel



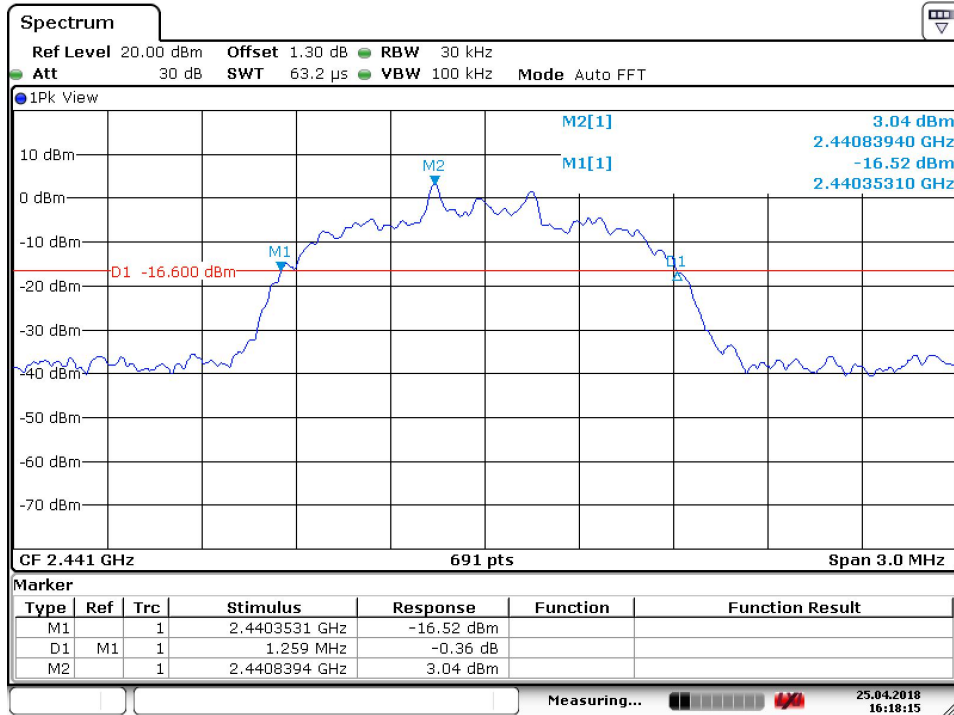
Date: 25.APR.2018 16:14:27

High Channel


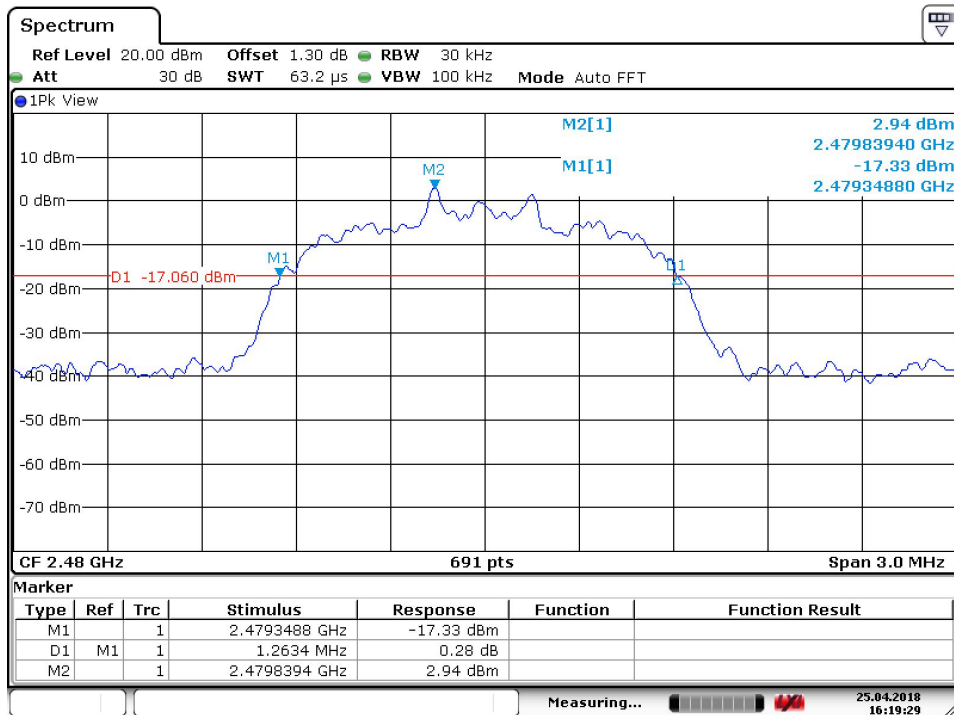
Date: 25.APR.2018 16:15:50

Test Plot of 20dB Bandwidth, 8DPSK modulation
Low Channel


Date: 25.APR.2018 16:17:02

Middle Channel


Date: 25.APR.2018 16:18:15

High Channel


Date: 25.APR.2018 16:19:29

5.1.4 Conducted spurious emissions and Frequency Band Edge measured in 100kHz Bandwidth

RESULT:**Passed**

Test standard	:	LP0002(2018): 3.10.1.5
Basic standard	:	LP0002(2018) Appendix II
Limit	:	20dB (below that in the 100kHz bandwidth within the band that contains the highest level of the desired power)
Kind of test site	:	Shielded room

Test setup

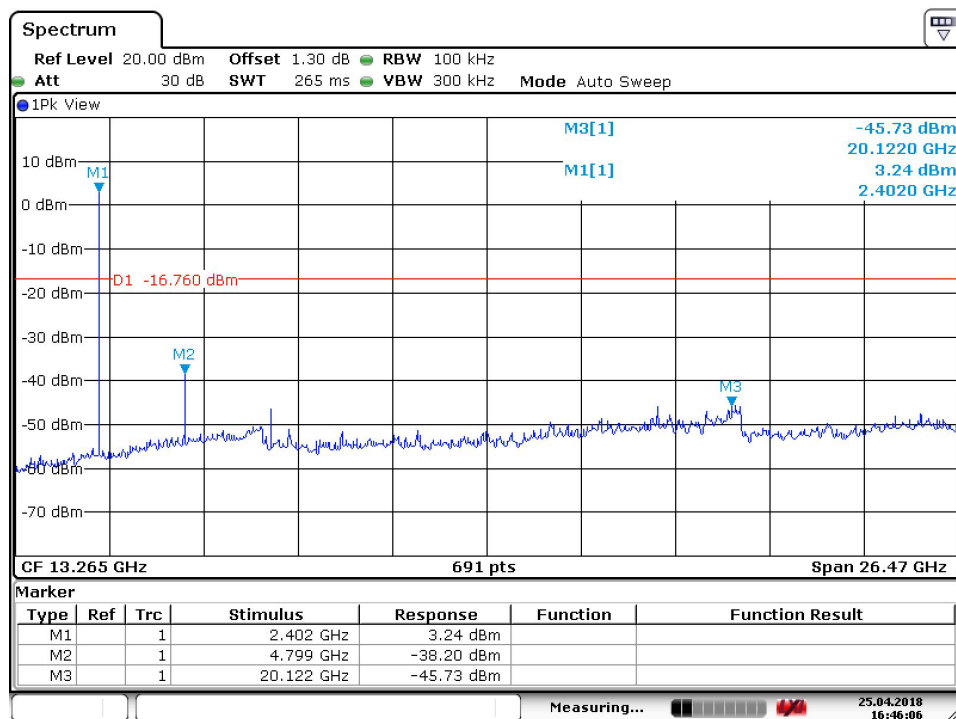
Test Channel	:	Low/ Middle/ High for Conducted Spurious Emissions Low/ High/ Hopping on for Frequency Band Edge
Operation Mode	:	A
Ambient temperature	:	22-26°C
Relative humidity	:	50-65%
Atmospheric pressure	:	100-103 kPa

All emissions are more than 20dB below fundamental, details refer to following test plot, and compliance is achieved as well.

Due to the small size of the product and that there are no inductive components of significant size, 9kHz to 30MHz frequency range is not tested based on technical judgment.

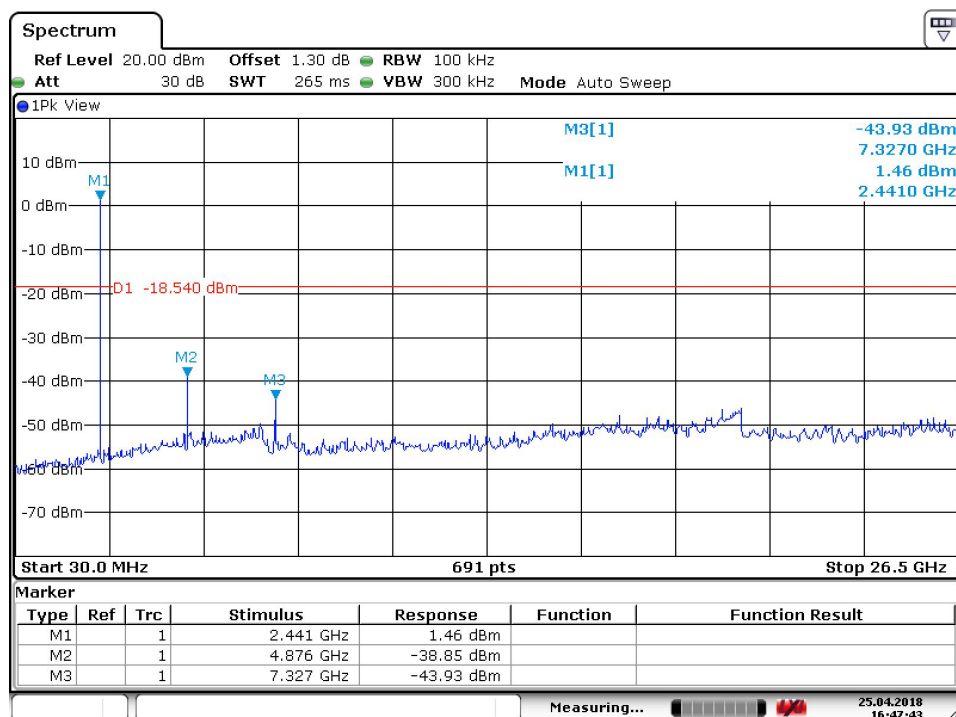
Test Plot of 100kHz Conducted Emissions, GFSK modulation

Low Channel



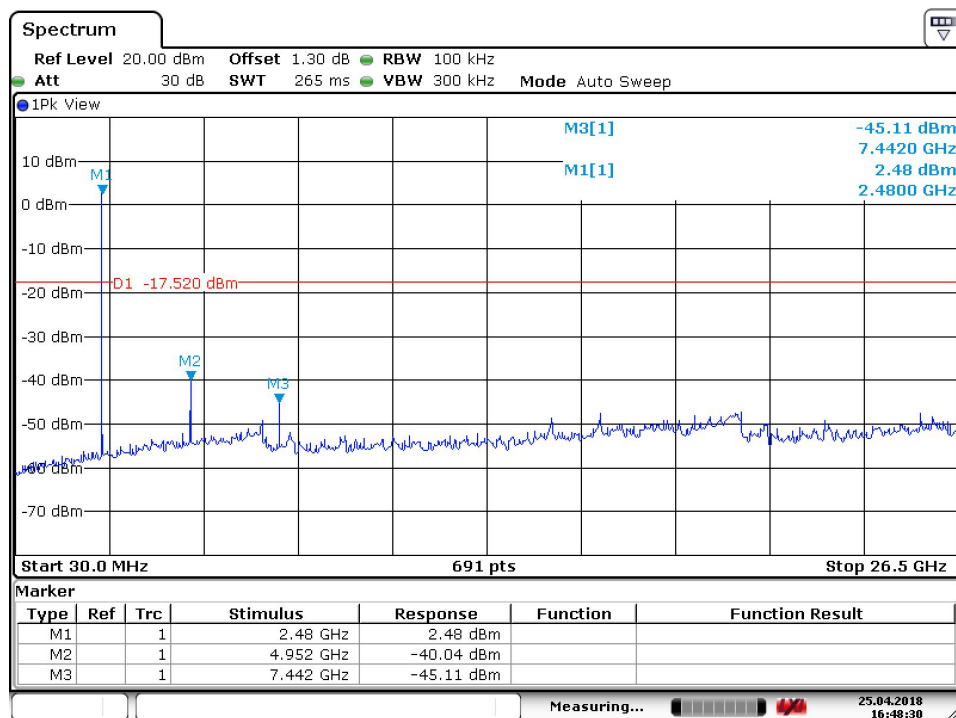
Date: 25.APR.2018 16:46:06

Middle Channel



Date: 25.APR.2018 16:47:43

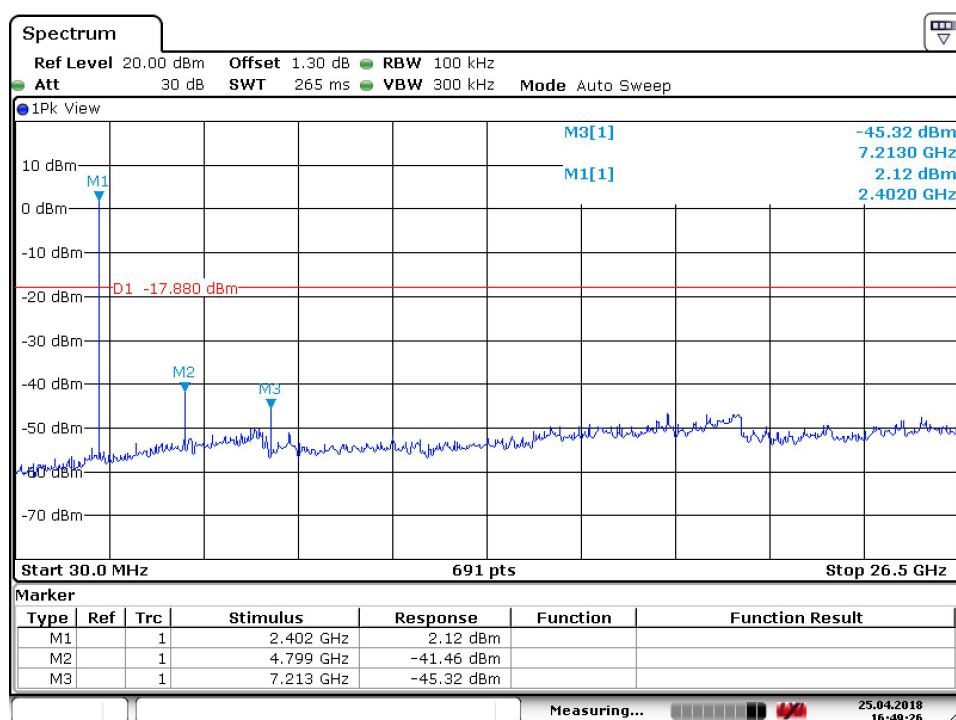
High Channel



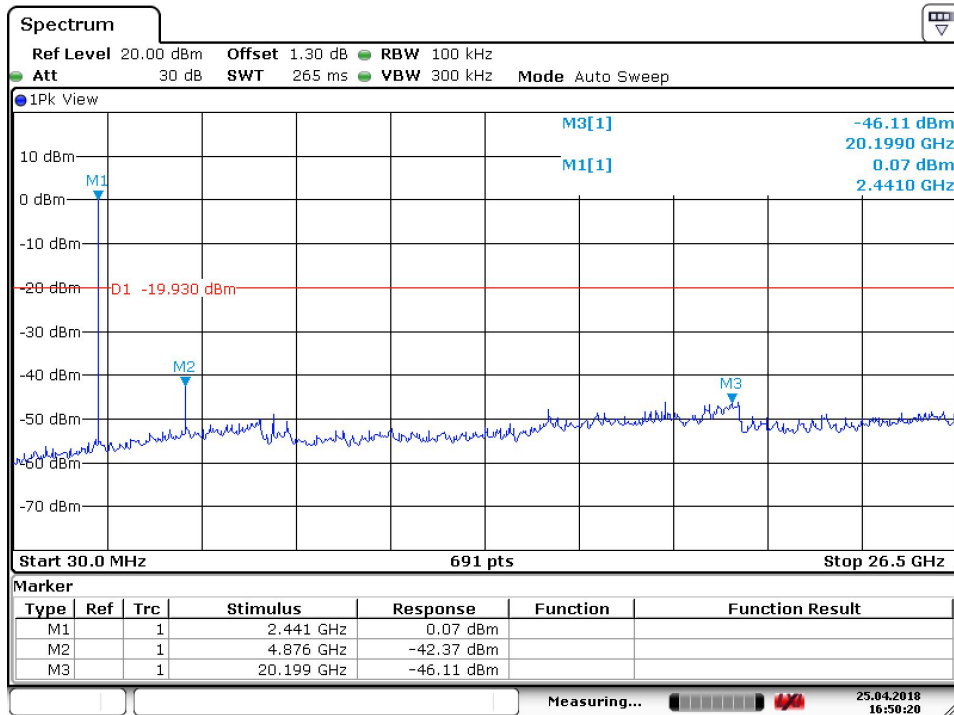
Date: 25.APR.2018 16:48:29

Test Plot of 100kHz Conducted Emissions, 8DPSK modulation

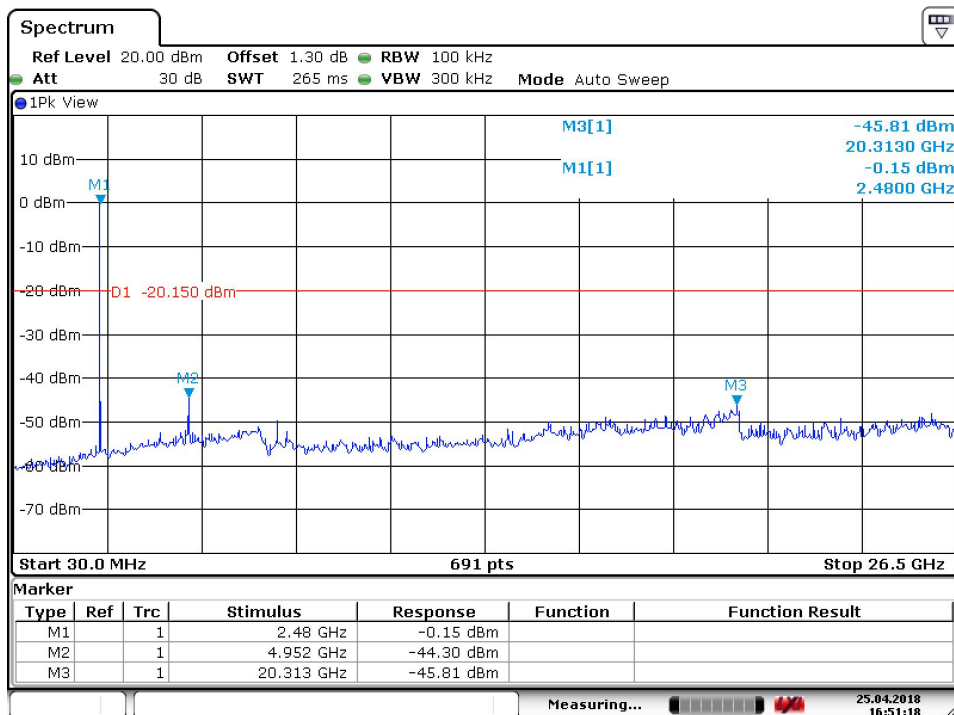
Low Channel



Date: 25.APR.2018 16:49:26

Middle Channel


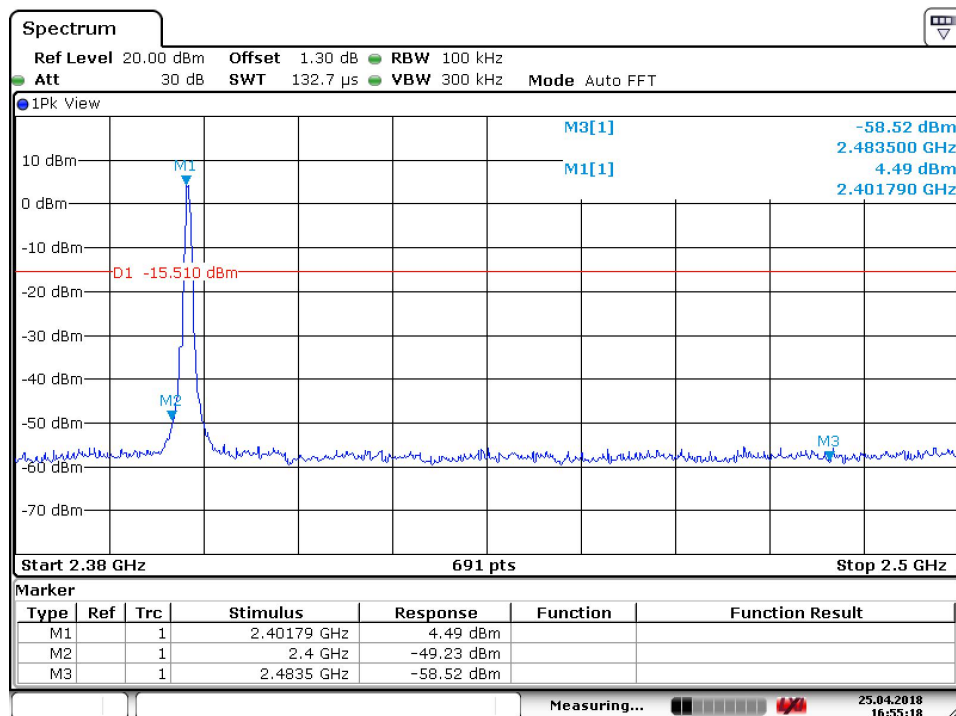
Date: 25.APR.2018 16:50:20

High Channel


Date: 25.APR.2018 16:51:18

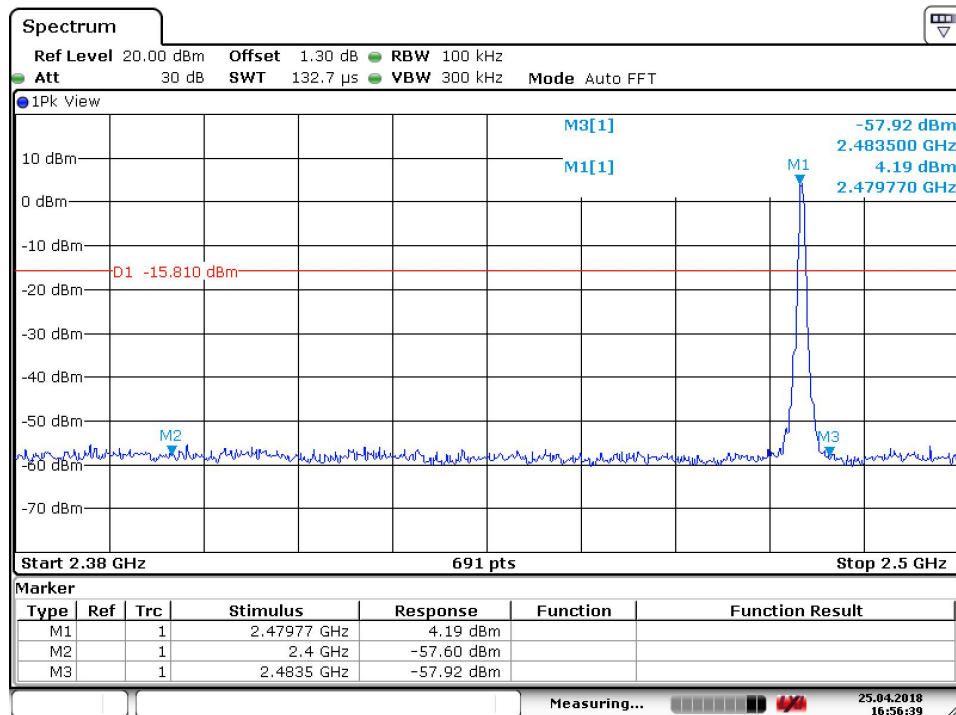
Test Plot of 100kHz Bandwidth of Frequency Band Edge, GFSK modulation

Low Channel

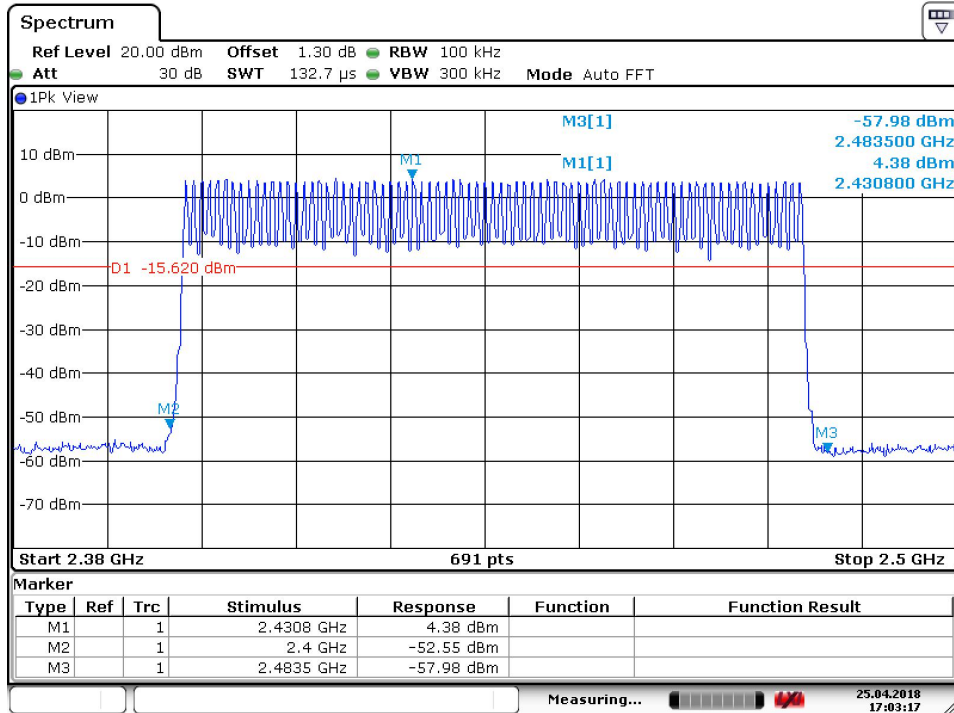


Date: 25.APR.2018 16:55:18

High Channel



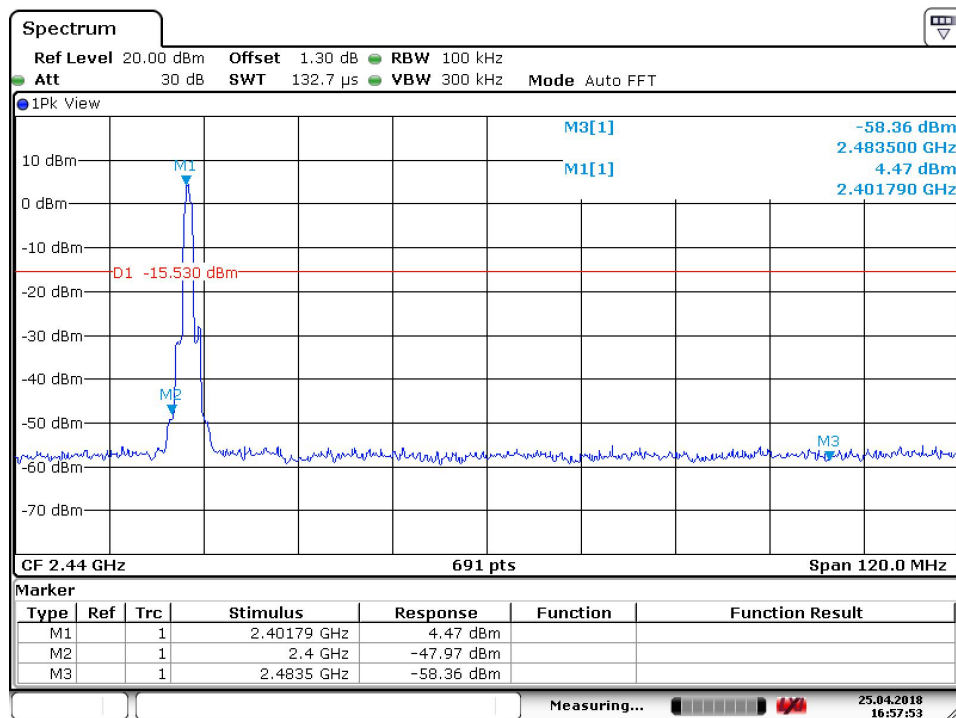
Date: 25.APR.2018 16:56:39

Hopping ON


Date: 25.APR.2018 17:03:17

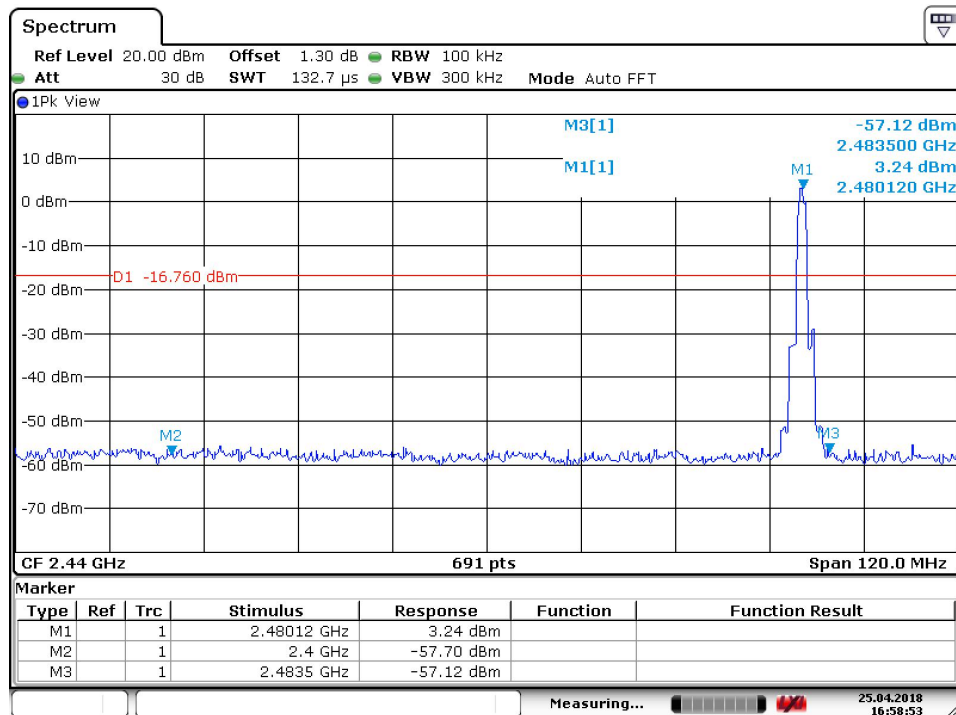
Test Plot of 100kHz Bandwidth of Frequency Band Edge, 8DPSK modulation

Low Channel

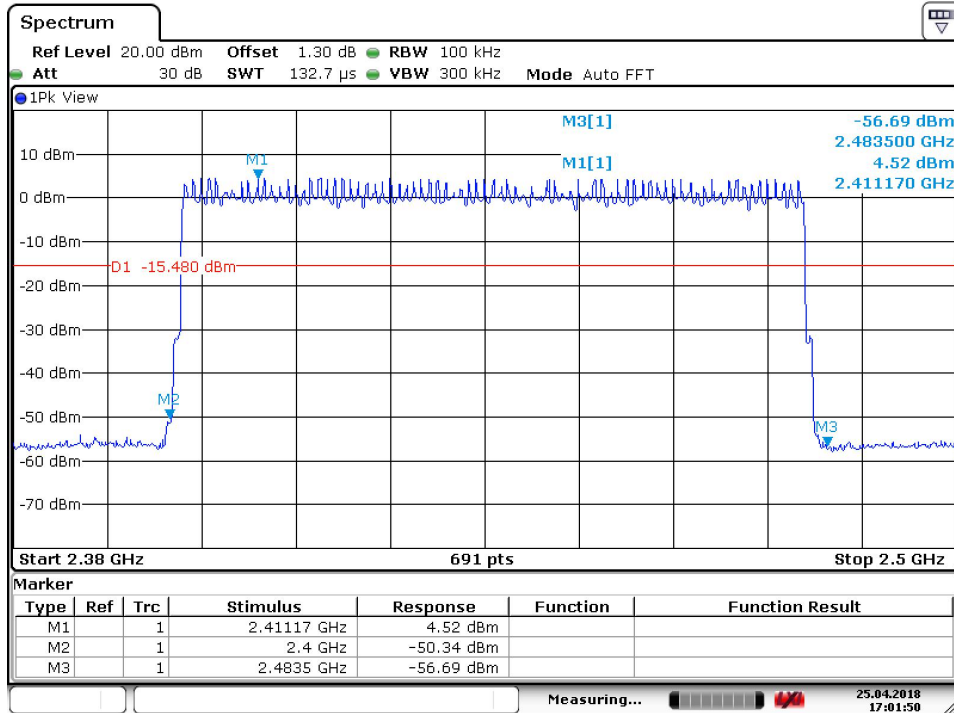


Date: 25.APR.2018 16:57:53

High Channel



Date: 25.APR.2018 16:58:53

Hopping ON


Date: 25.APR.2018 17:01:49