

Prüfbericht-Nr.: Test Report No.:	50347359 001	Auftrags-Nr.: Order No.:	244218640	Seite 1 von 103 Page 1 of 103
Kunden-Referenz-Nr.: Client Reference No.:	472415	Auftragsdatum: Order date:	24.02.2020	
Auftraggeber: Client:	Yanfeng Visteon Automotive Electronics Co., Ltd. 300 Minolta Road Songjiang County Shanghai, China			
Prüfgegenstand: Test item:	MB Audio System			
Bezeichnung / Typ-Nr.: Identification / Type No.:	VS20 FCC ID: RQ9VS20			
Auftrags-Inhalt: Order content:	Complete test			
Prüfgrundlage: Test specification:	FCC CFR47 Part 15, Subpart C Section 15.247 KDB 558074 D01 15.247 Meas Guidance v05r02 ANSI C63.10: 2013			
Wareneingangsdatum: Date of receipt:	27.02.2020			
Prüfmuster-Nr.: Test sample No.:	A001067791-004~005			
Prüfzeitraum: Testing period:	27.02.2020 to 08.04.2020			
Ort der Prüfung: Place of testing:	TÜV Rheinland (Shanghai) Co., Ltd.			
Prüflaboratorium: Testing laboratory:	TÜV Rheinland (Shanghai) Co., Ltd.			
Prüfergebnis*: Test result*:	Pass			
geprüft von / tested by:		kontrolliert von / reviewed by:		
10.04.2020 Elliot Zhang / PE		10.04.2020 Hongfei Wu / Reviewer		
Datum Date	Name / Stellung Name / Position	Unterschrift Signature	Datum Date	Name / Stellung Name / Position
Sonstiges / Other				
Zustand des Prüfgegenstandes bei Anlieferung: Condition of the test item at delivery:		Prüfmuster vollständig und unbeschädigt Test item complete and undamaged		
* 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. 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.				

TEST SUMMARY

5.1.1 ANTENNA REQUIREMENT*RESULT: Pass***5.1.2 20DB & 99% BANDWIDTH***RESULT: Pass***5.1.3 PEAK OUTPUT POWER***RESULT: Pass***5.1.4 FREQUENCY SEPARATION***RESULT: Pass***5.1.5 NUMBER OF HOPPING FREQUENCY***RESULT: Pass***5.1.6 TIME OF OCCUPANCY***RESULT: Pass***5.1.7 CONDUCTED BAND-EDGE***RESULT: Pass***5.1.8 CONDUCTED SPURIOUS EMISSIONS***RESULT: Pass***5.2.1 CONDUCTED EMISSION***RESULT: N/A***5.3.1 RADIATED BAND-EDGE***RESULT: Pass***5.3.2 RADIATED SPURIOUS EMISSION***RESULT: Pass*

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1. General Remarks

1.1 Complementary Materials

Null.

2. Test Sites

2.1 Test Facilities

TÜV Rheinland (Shanghai) Co., Ltd.

Shanghai TUV Rheinland Building No. 177, 178 Lane 777, West Guangzhong Rd, Jing'an District, Shanghai, China

The used test equipment is in accordance with CISPR 16 for measurement of radio interference.

The Federal Communications Commission has reviewed the technical characteristics of the radiated and conducted emission facility, and has found these test facilities to be in compliance with the requirements of section 2.948 of the FCC rules. The description of the test facility is listed under FCC registration number 958801.

The Innovation, Science and Economic Development Canada has reviewed the technical characteristics of the radiated and conducted emission facility, and has found these test facilities to be in compliance. The description of the test facility is listed under chambers filing number 2932F.

2.2 List of Test and Measurement Instruments

Table 1: List of Test and Measurement Equipment

Instrument	Manufacturer	Type No.	Asset No.	Cali. Due Date
3m Anechoic Chamber	Frankonia	SAC3	FJ129002	13.05.2022
EMI Test Receiver	R&S	ESCI	100280	31.10.2020
Spectrum Analyzer	R&S	FSV40	101258	31.10.2021
BiLog Antenna	Teseq	CBL 6112D	40530	13.02.2021
Log-periodic Antenna	R&S	HL050	100692	16.02.2021
Preamplifier	Taiwan EMC Instruments Corporation	EMC051845SE	980612	05.03.2021
Broadband Horn Antenna	Schwarzbeck	BBHA 9170	9170-305	09.07.2021
Preamplifier	Taiwan EMC Instruments Corporation	EMC184045SE	980596	05.03.2021
Spectrum Analyzer	Keysight	N9020A	MY54500180	09.05.2020
DC Power Supply	ALLPOWER	ADC50-20	99223	12.10.2020
Thermohygrometer	Testo	608-H1	1241320614	13.10.2020

2.3 Traceability

All measurement equipment calibrations are traceable to NIST or where calibration is performed outside the United States, to equivalent nationally recognized standards organizations.

2.4 Calibration

Equipment requiring calibration is calibrated periodically by the manufacturer or according to manufacturer's specifications. Additionally all equipment is verified for proper performance on a regular basis using in house standards or comparisons.

2.5 Measurement Uncertainty

Table 2: Measurement Uncertainty

Measurement Type	Frequency	Uncertainty
Antenna Port Conducted Emission	< 1GHz	±0.39dB
	> 1GHz	±0.68dB
Radiated Emission	9kHz - 30MHz	±2.93 dB
	30MHz - 1GHz	±5.34dB
	> 1GHz	±5.40dB

3. General Product Information

3.1 Product Function and Intended Use

The EUT (Equipment Under Test) is a Car Radio which support Bluetooth Classic function.

The aim of this report is to evaluate the RF characteristic of the Bluetooth Classical Part of this product.

For details refer to the User Manual and Circuit Diagram.

3.2 Ratings and System Details

Table 3: Technical Specification of EUT

General Description of EUT	
Product Name:	MB Audio System
Model No.:	VS20
Rated Voltage:	DC 13V
Bluetooth Classical	
Frequency Range:	2402 - 2480MHz
Channel No.:	79
Modulation Type:	GFSK, $\pi/4$ DQPSK, 8DPSK
Data Rate:	1Mbps(GFSK), 2Mbps($\pi/4$ DQPSK), 3Mbps(8DPSK)
Antenna Type:	PCB Antenna
Antenna Gain:	-1dBi

3.3 Independent Operation Modes

Table 4: Test Modes

Test Mode	Data Rate	Channel
TM1	1-DH5	00
TM2	1-DH5	39
TM3	1-DH5	78
TM4	2-DH5	00
TM5	2-DH5	39
TM6	2-DH5	78
TM7	3-DH5	00
TM8	3-DH5	39
TM9	3-DH5	78
TM10	1-DH1	Hopping
TM11	1-DH3	Hopping
TM12	1-DH5	Hopping
TM13	2-DH1	Hopping
TM14	2-DH3	Hopping
TM15	2-DH5	Hopping
TM16	3-DH1	Hopping
TM17	3-DH3	Hopping
TM18	3-DH5	Hopping

3.4 Noise Generating and Noise Suppressing Parts

Refer to the Circuit Diagram.

3.5 Submitted Documents

- Bill of Material
- PCB Layout
- Photo Document
- Circuit Diagram
- Instruction Manual
- Rating Label

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

Test operation refers to test setup in chapter 5. All testing were performed according to the procedures in ANSI C63.10: 2013.

4.3 Special Accessories and Auxiliary Equipment

Null.

4.4 Countermeasures to achieve EMC Compliance

Null.

5. Test Results

5.1 Conducted Testing at Antenna Port

5.1.1 Antenna Requirement

RESULT:**Pass**

According to the manufacturer declared, the EUT has one PCB antenna, the directional gain of antenna is -1 dBi and the antenna is designed with permanent attachment and no consideration of replacement. Therefore the EUT is considered sufficient to comply with the provision.

Table 5: Antenna Requirement

FCC 15.203 – Antenna Requirement 1		
Requirement:	No antenna other than that furnished by the responsible party shall be used with the device	
Results:	Antenna type:	PCB antenna
Verdict:	PASS	

FCC 15.204 – Antenna Requirement 2		
Requirement:	An intentional radiator may be operated only with the antenna with which it is authorized. If an antenna is marketed with the intentional radiator, it shall be of a type which is authorized with the intentional radiator.	
Results:	Only one integral antenna can be used	
Verdict:	PASS	

5.1.2 20dB & 99% Bandwidth**RESULT:****Pass**

Date of testing : 27.02.2020
Ambient temperature : 23.2°C
Relative humidity : 45.7%
Atmospheric pressure : 101kPa
Test requirement : FCC Part 15.247(a)(1)
Test procedure : KDB 558074 D01v05r02
ANSI C63.10: 2013
Test voltage : DC 13V
Test modes applied : TM1 to TM9

Table 6: 20dB & 99% Bandwidth, TM1 to TM9

Test Mode	Mode	CH.	Freq. [MHz]	20dB Bandwidht [kHz]	99% Bandwidth [kHz]
TM1	1-DH5	00	2402	955.0	886.11
TM2	1-DH5	39	2441	955.1	876.20
TM3	1-DH5	78	2480	954.7	879.33
TM4	2-DH5	00	2402	1279	1176.4
TM5	2-DH5	39	2441	1275	1171.0
TM6	2-DH5	78	2480	1244	1103.4
TM7	3-DH5	00	2402	1274	1161.7
TM8	3-DH5	39	2441	1277	1160.1
TM9	3-DH5	78	2480	1274	1161.7

Note:

For frequency hopping systems operating in the 2400 – 2483.5MHz band, no bandwidth limit is specified. The test data is provide for reference.

And according to FCC, when the occupied bandwidth limit is not stated in the applicable FCC or reference measurement method, the transmitted signal band width shall be reported as the 99% emission bandwidth.

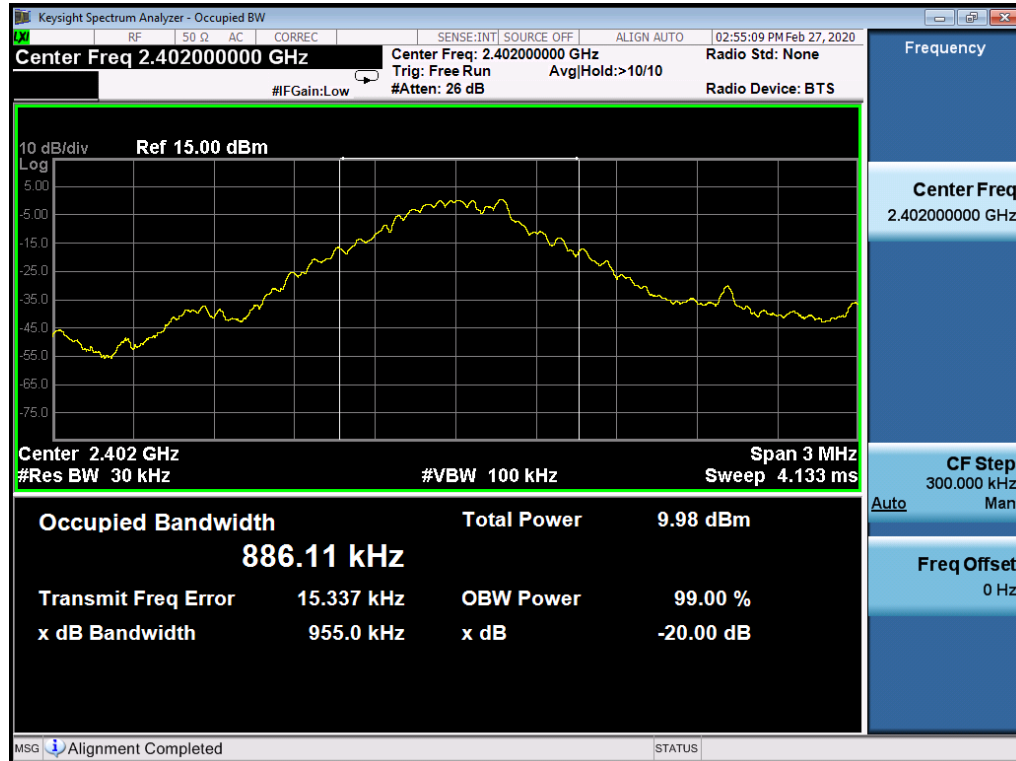
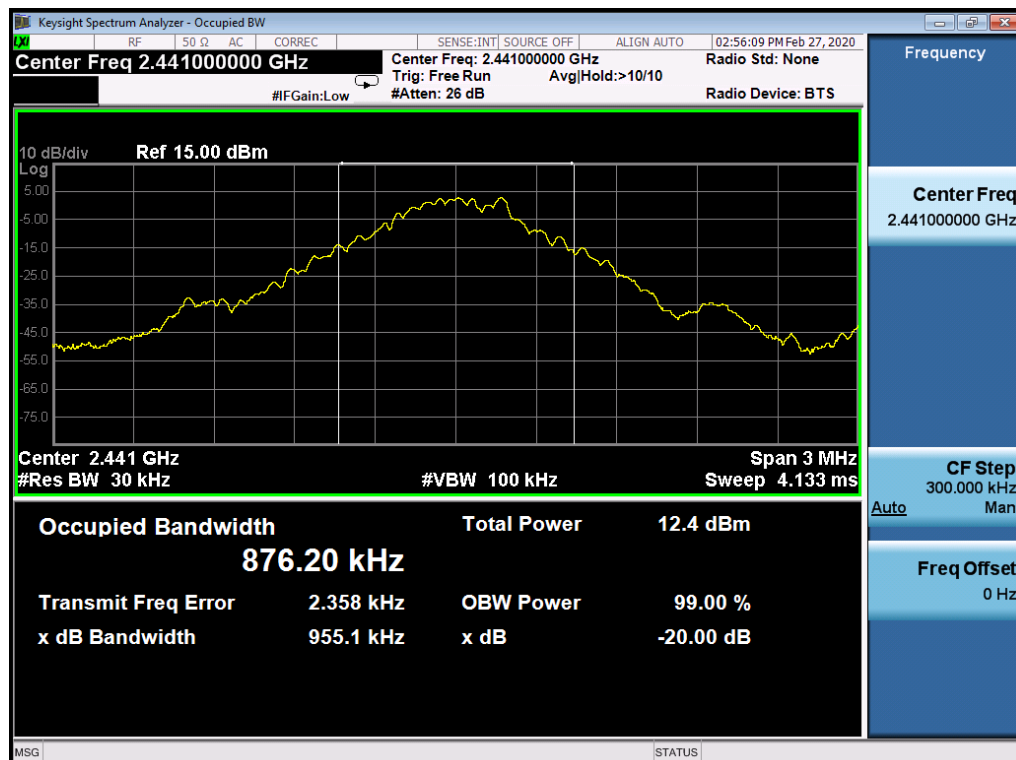
Figure 1: 20dB & 99% Bandwidth, TM1

Figure 2: 20dB & 99% Bandwidth, TM2


Figure 3: 20dB & 99% Bandwidth, TM3

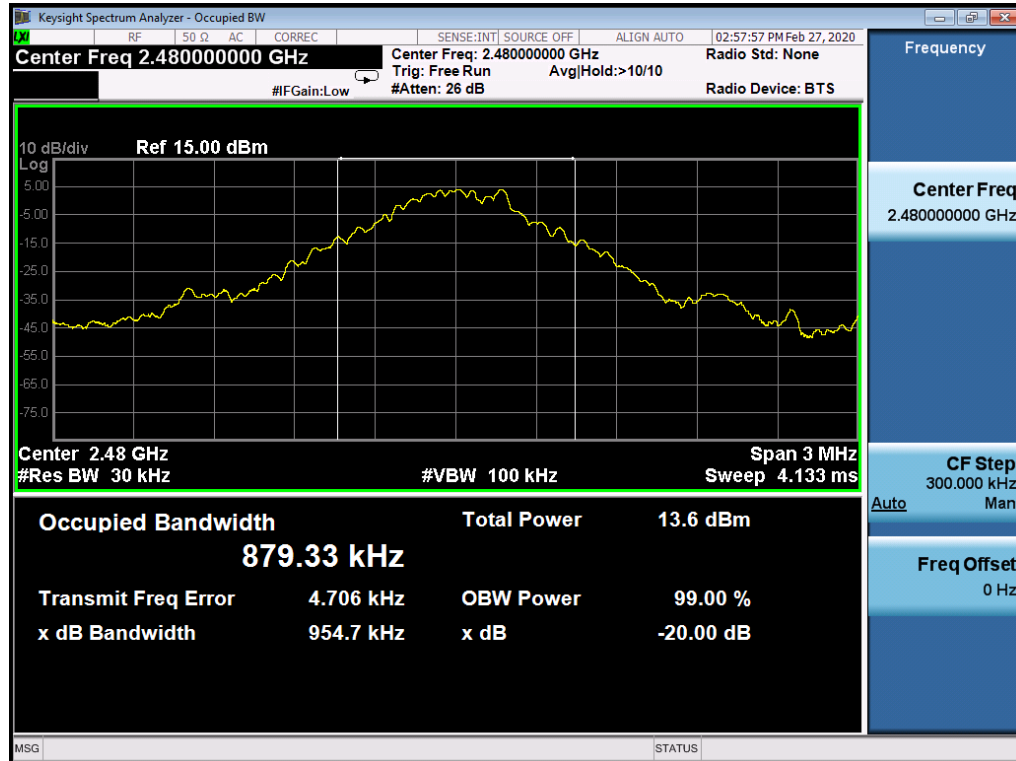


Figure 4: 20dB & 99% Bandwidth, TM4

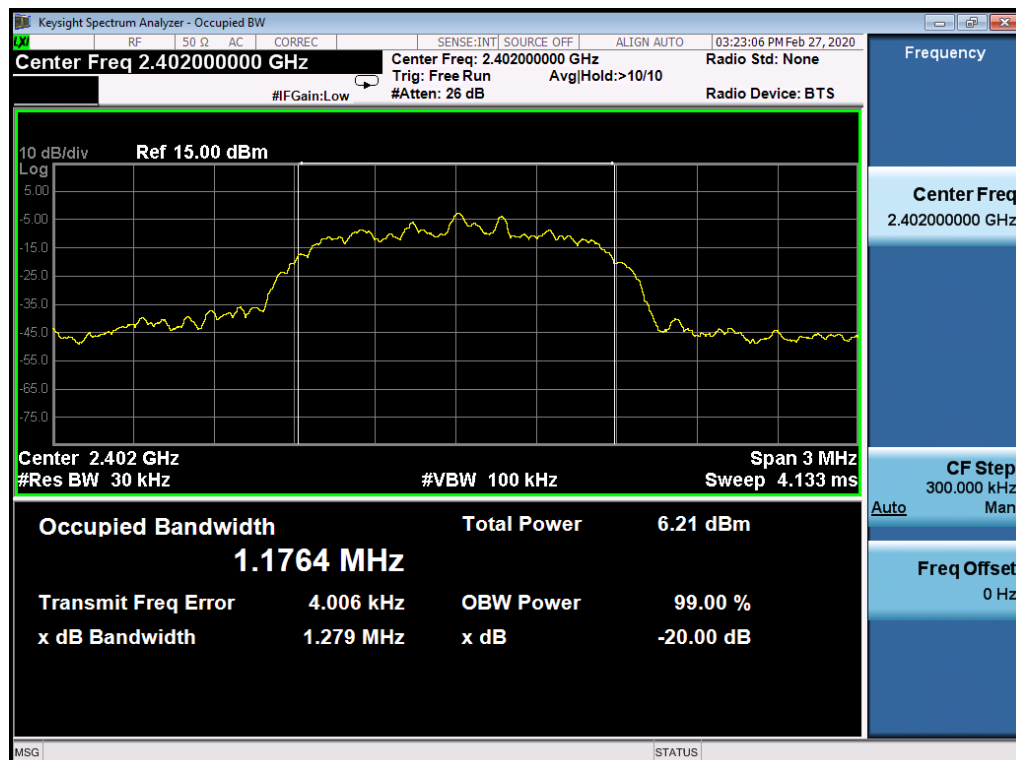


Figure 5: 20dB & 99% Bandwidth, TM5

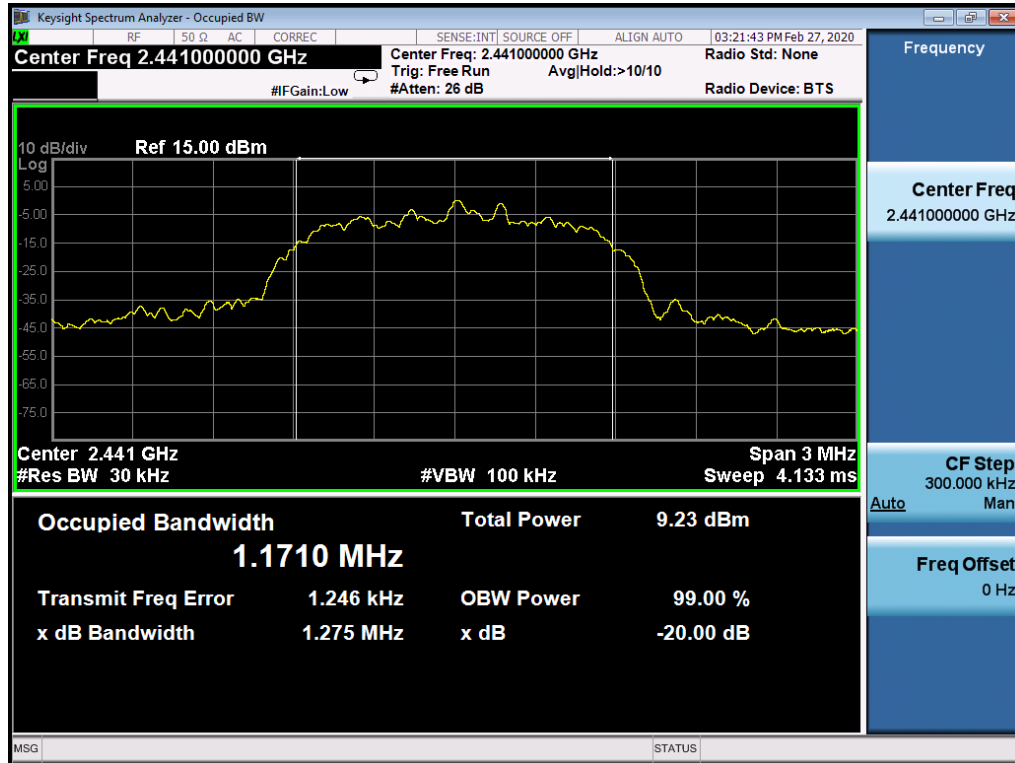


Figure 6: 20dB & 99% Bandwidth, TM6

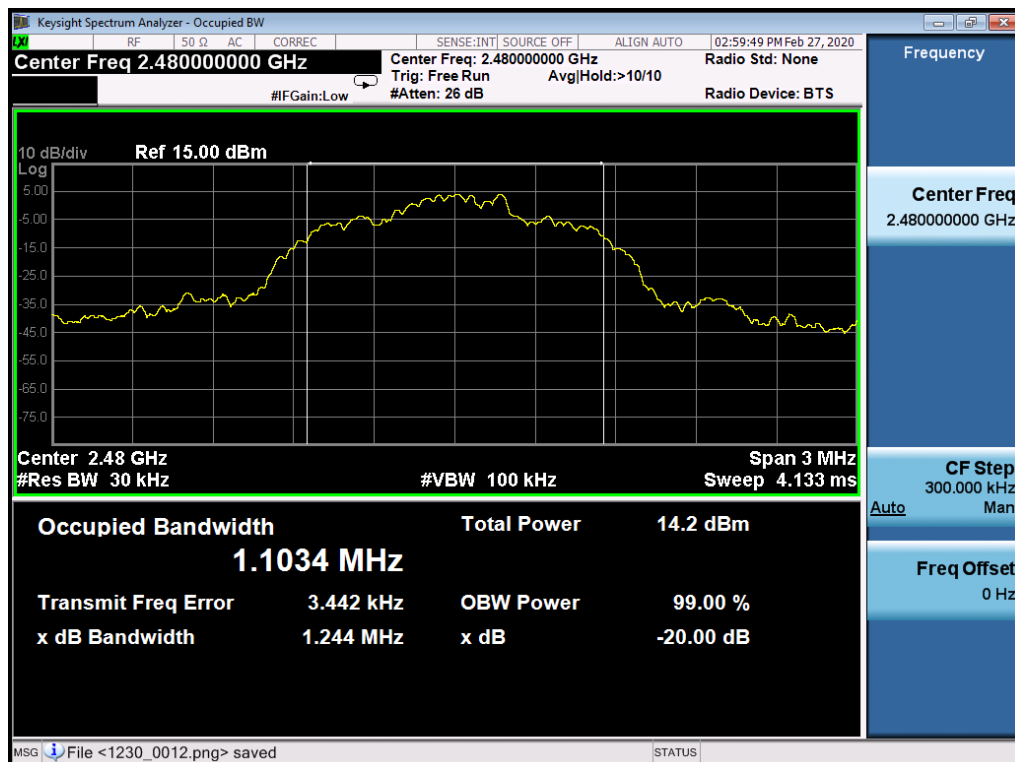


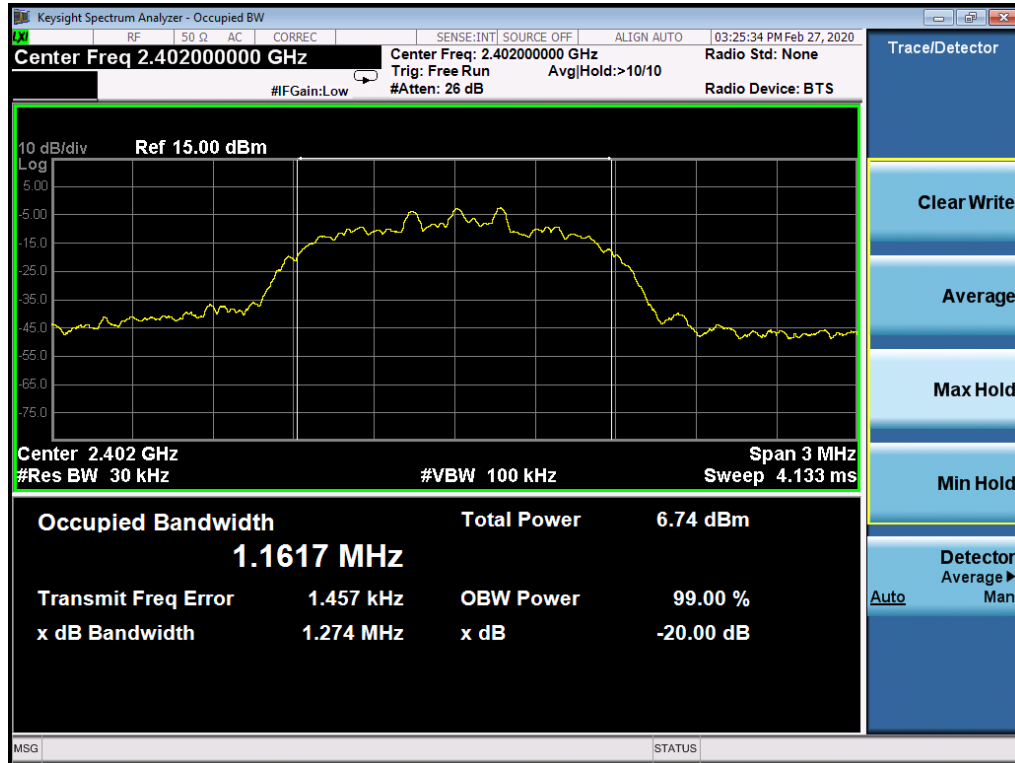
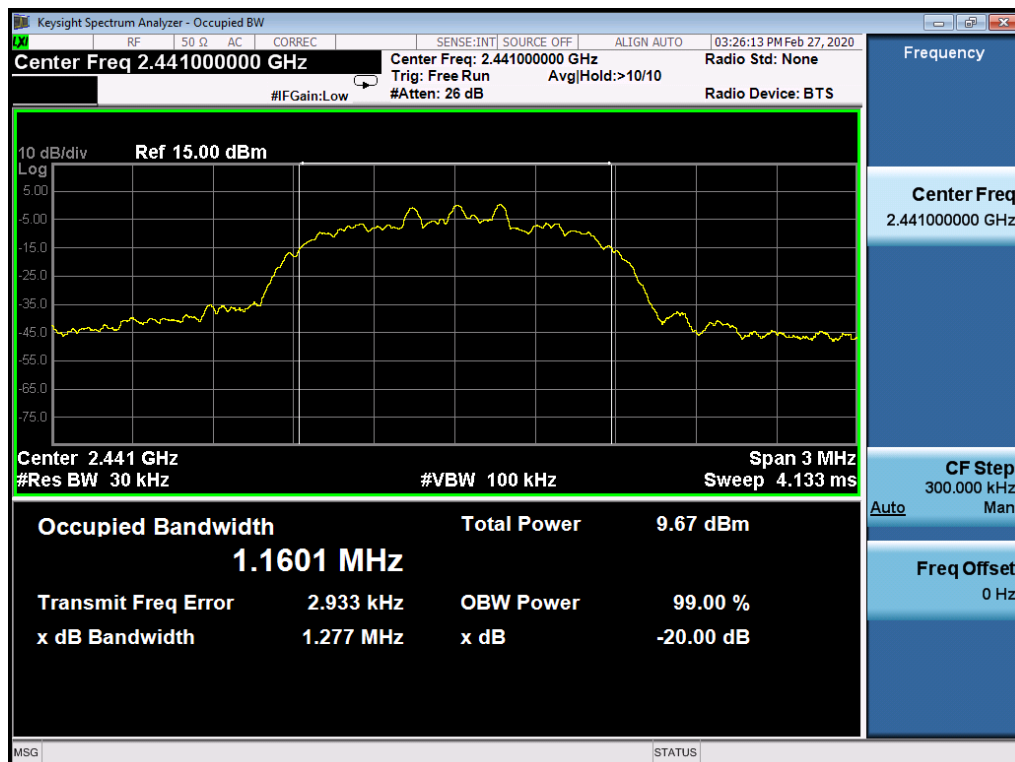
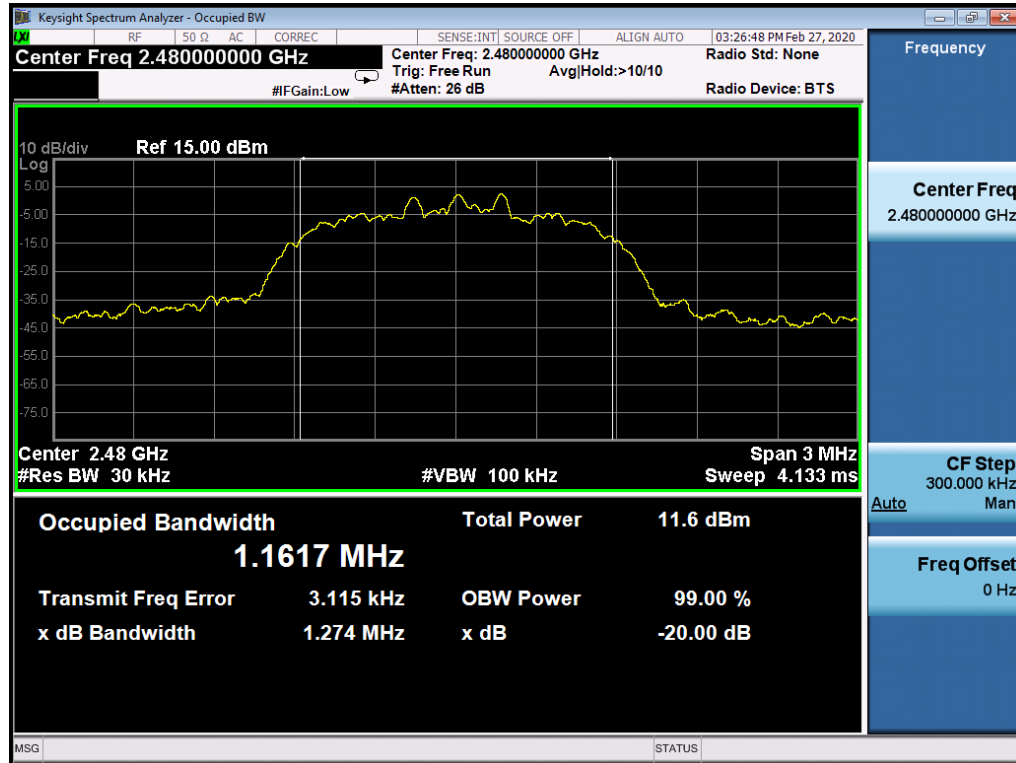
Figure 7: 20dB & 99% Bandwidth, TM7

Figure 8: 20dB & 99% Bandwidth, TM8


Figure 9: 20dB & 99% Bandwidth, TM9


Note:
EIRP=Peak Conducted Output Power + Antenna Gain

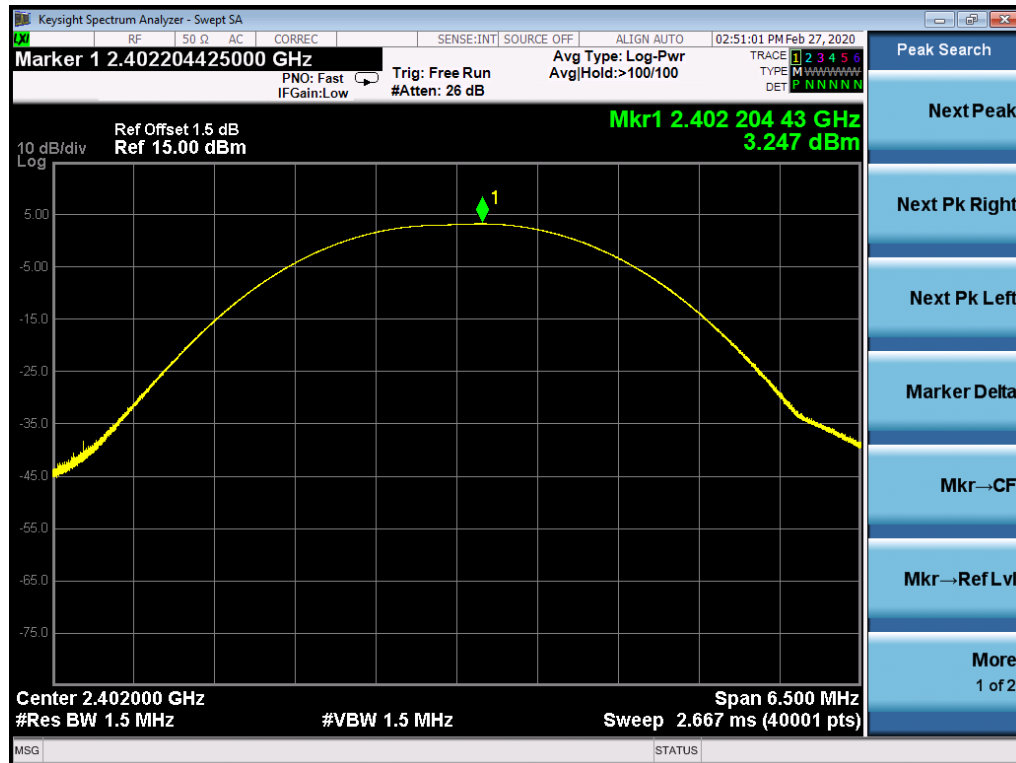
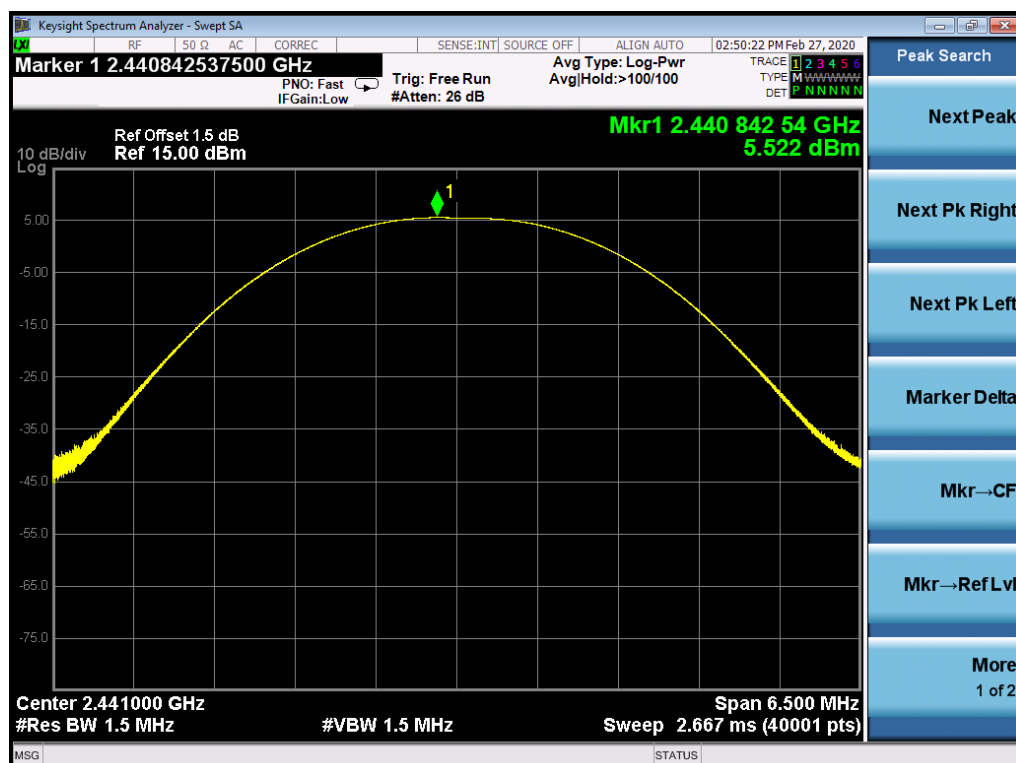
Figure 10: Peak Output Power, TM1

Figure 11: Peak Output Power, TM2


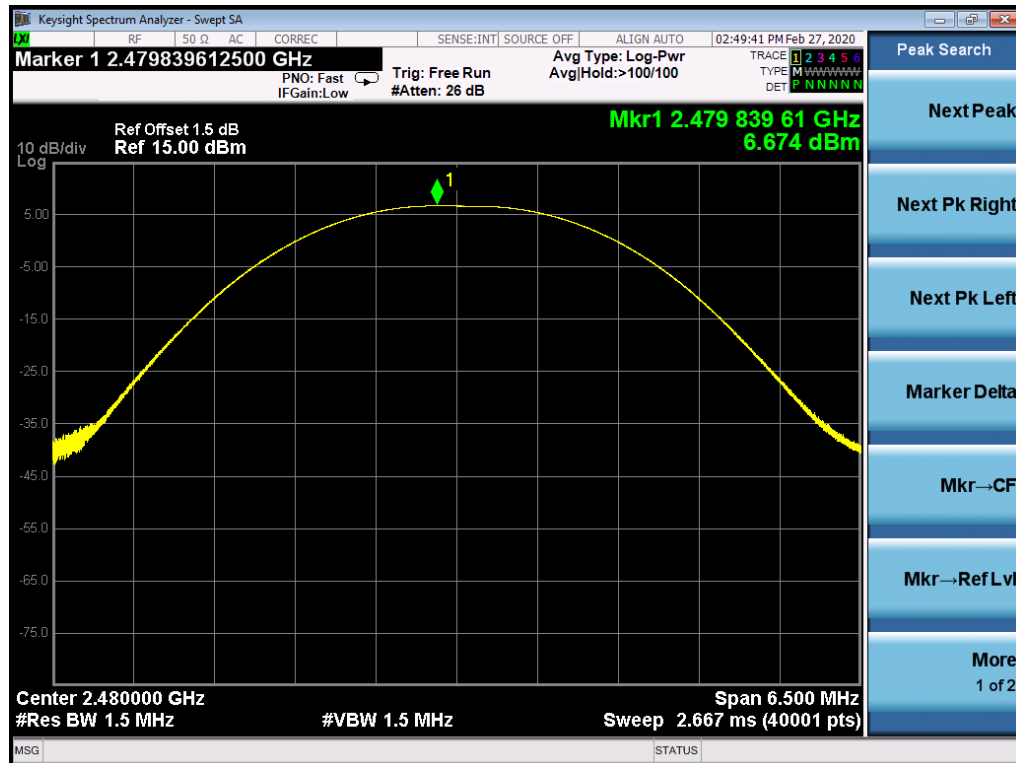
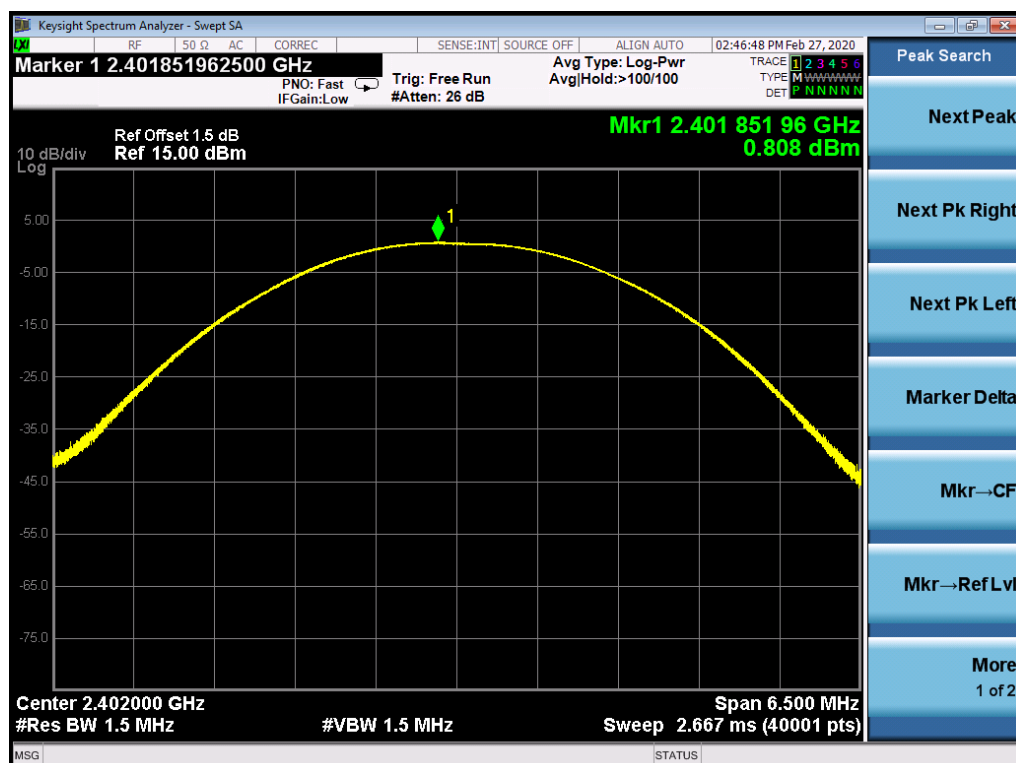
Figure 12: Peak Output Power, TM3

Figure 13: Peak Output Power, TM4


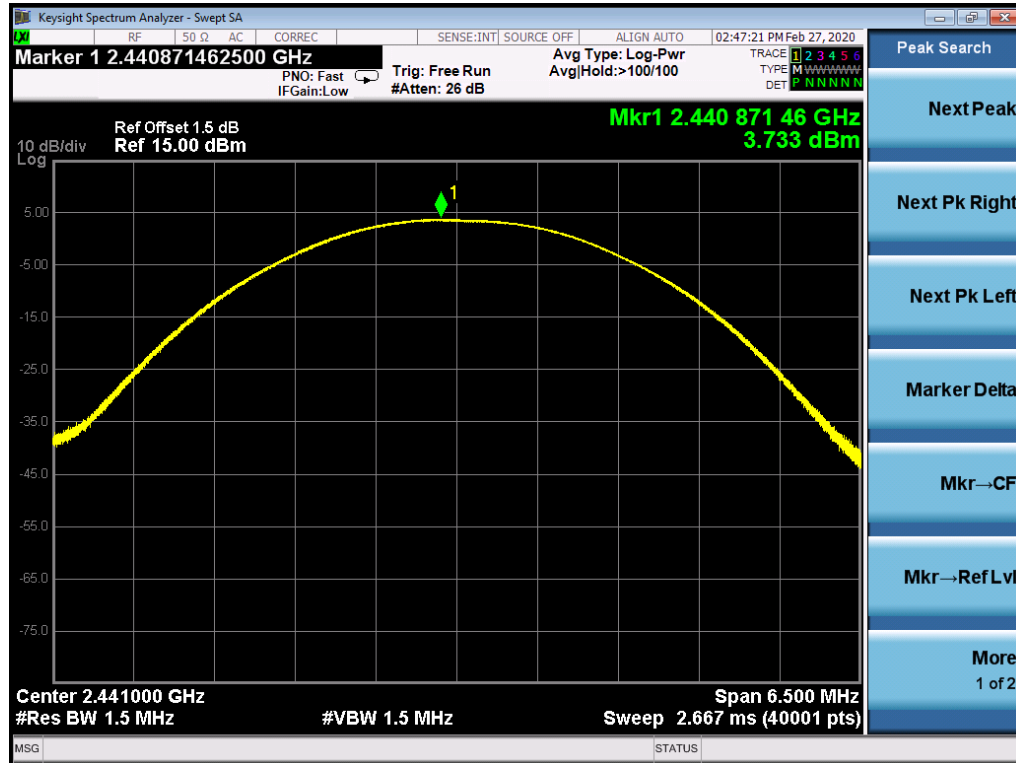
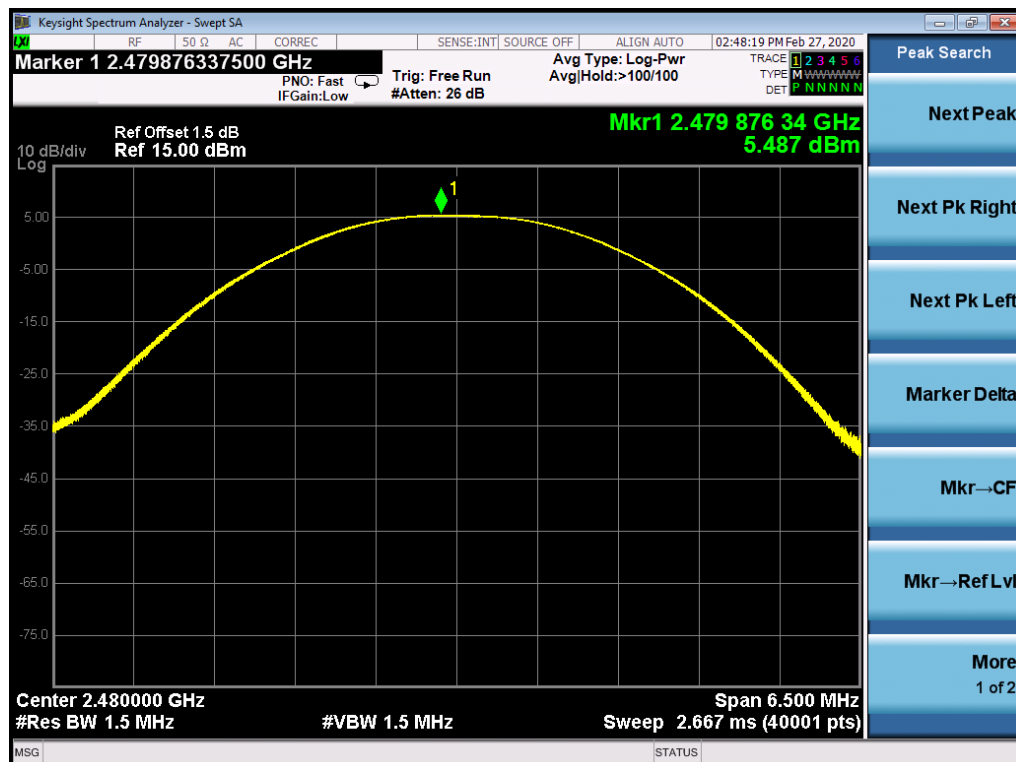
Figure 14: Peak Output Power, TM5

Figure 15: Peak Output Power, TM6


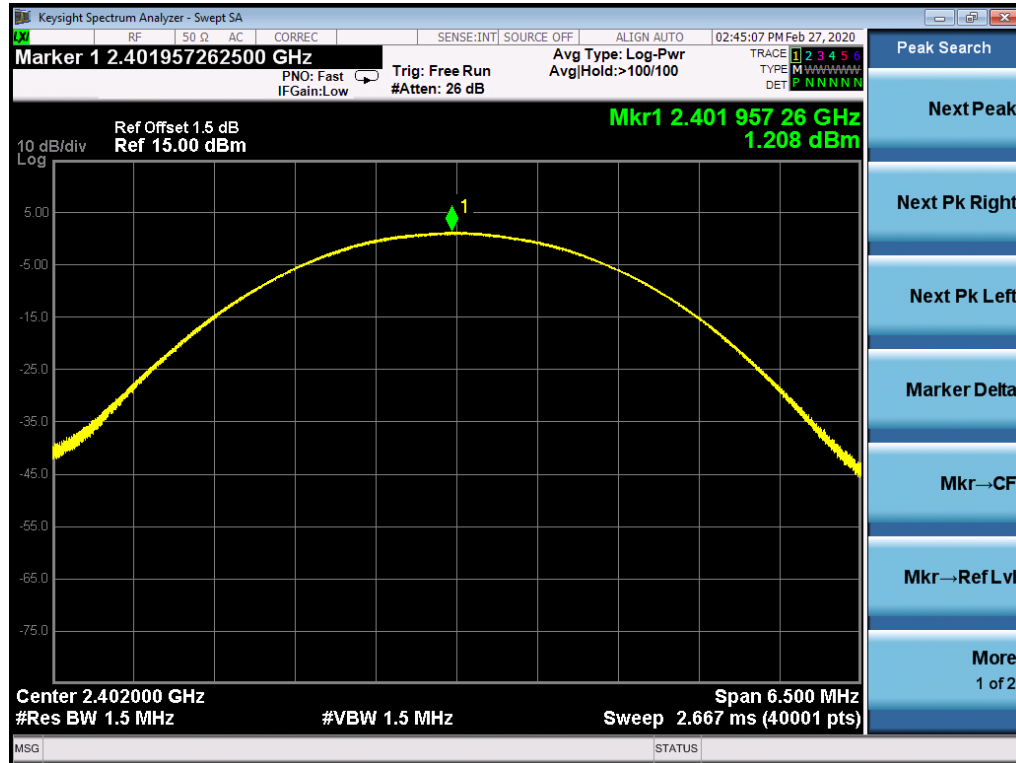
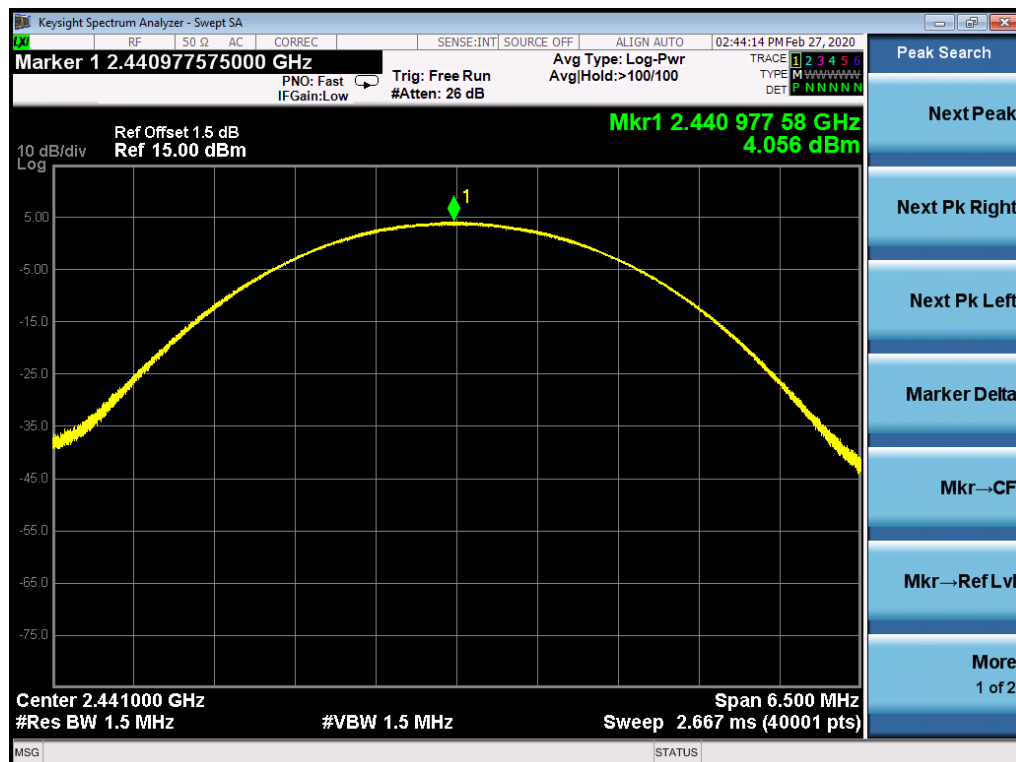
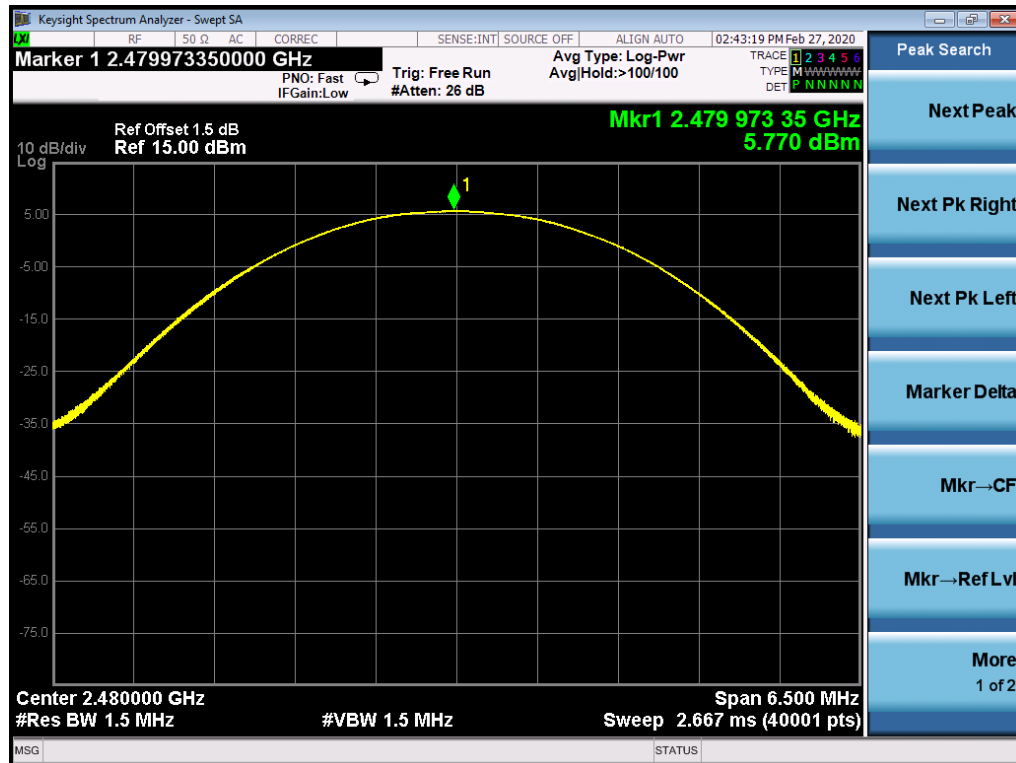
Figure 16: Peak Output Power, TM7

Figure 17: Peak Output Power, TM8


Figure 18: Peak Output Power, TM9



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.

Figure 19: Frequency Separation, TM12, observation Frequency 2402MHz

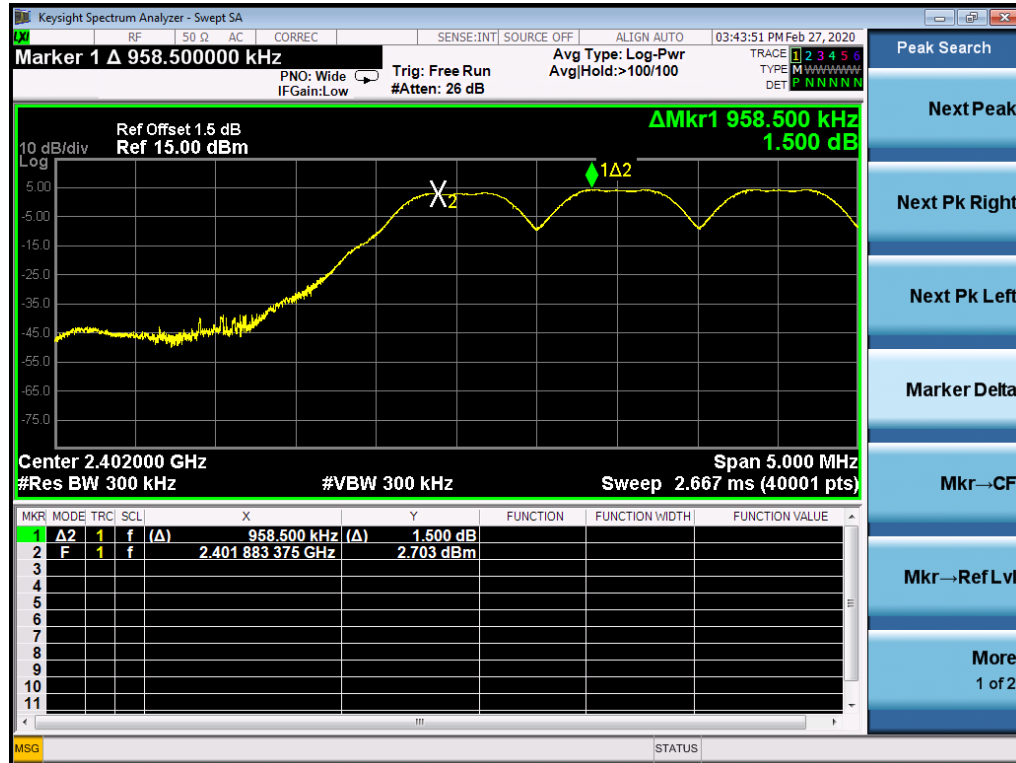


Figure 20: Frequency Separation, TM12, observation Frequency 2441MHz

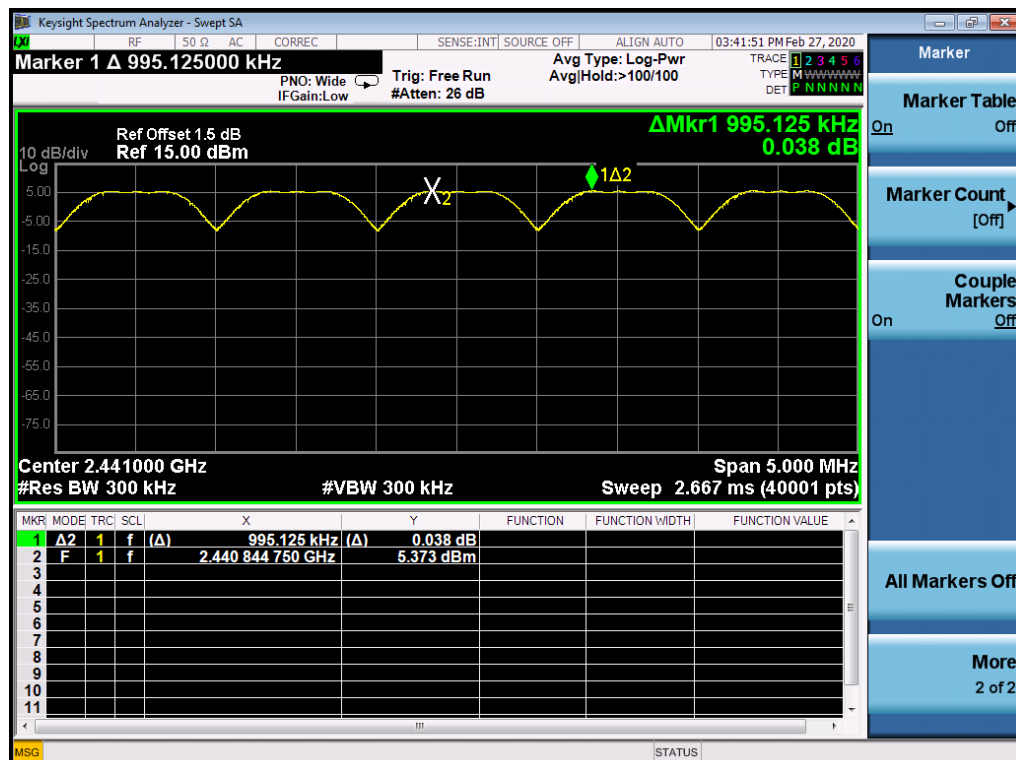


Figure 21: Frequency Separation, TM12, observation Frequency 2480MHz



Figure 22: Frequency Separation, TM15, observation Frequency 2402MHz

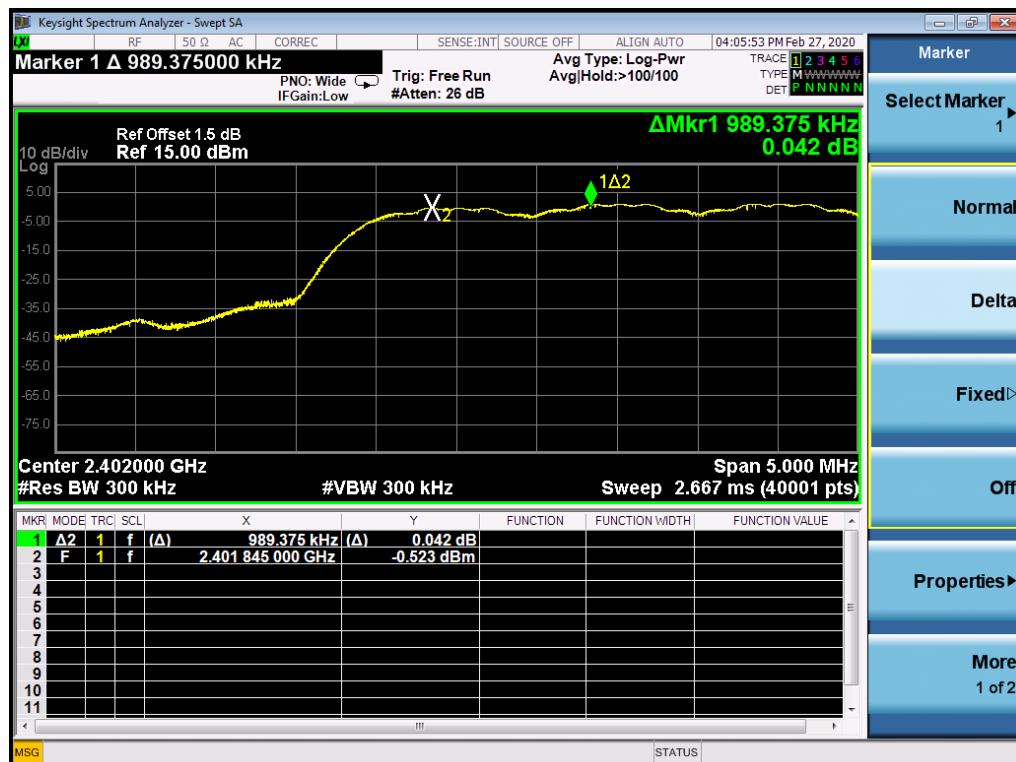


Figure 23: Frequency Separation, TM15, observation Frequency 2441MHz

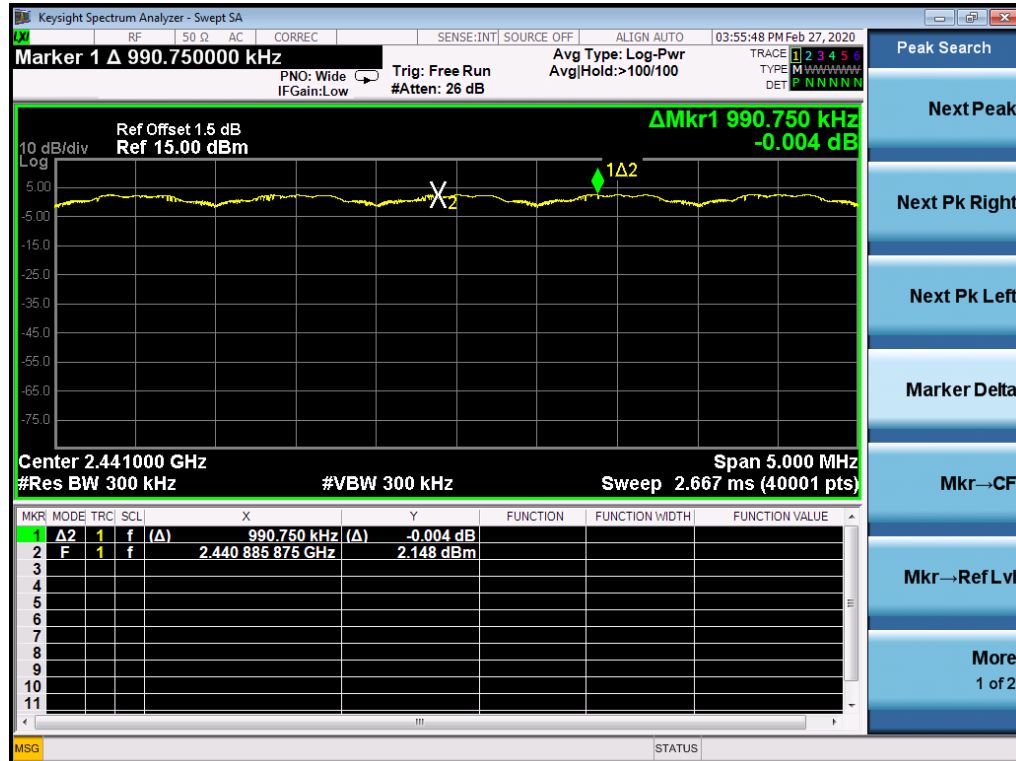


Figure 24: Frequency Separation, TM15, observation Frequency 2480MHz



Figure 25: Frequency Separation, TM18, observation Frequency 2402MHz



Figure 26: Frequency Separation, TM18, observation Frequency 2441MHz





5.1.5 Number of Hopping Frequency

RESULT:**Pass**

Date of testing : 27.02.2020
Ambient temperature : 23.1°C
Relative humidity : 45.7%
Atmospheric pressure : 101kPa
Test requirement : FCC 15.247(a)(1)(iii)
Test procedure : KDB 558074 D01v05r02
ANSI C63.10: 2013
Test voltage : DC 13V
Test modes applied : TM12, TM15, TM18

Table 9: Number of Hopping Frequency

Frequency Range	Measured Quantity of Hopping Channel	Limit
2402 to 2480	79	≥15

Figure 28: Number of Hopping Frequency, TM12, part 1

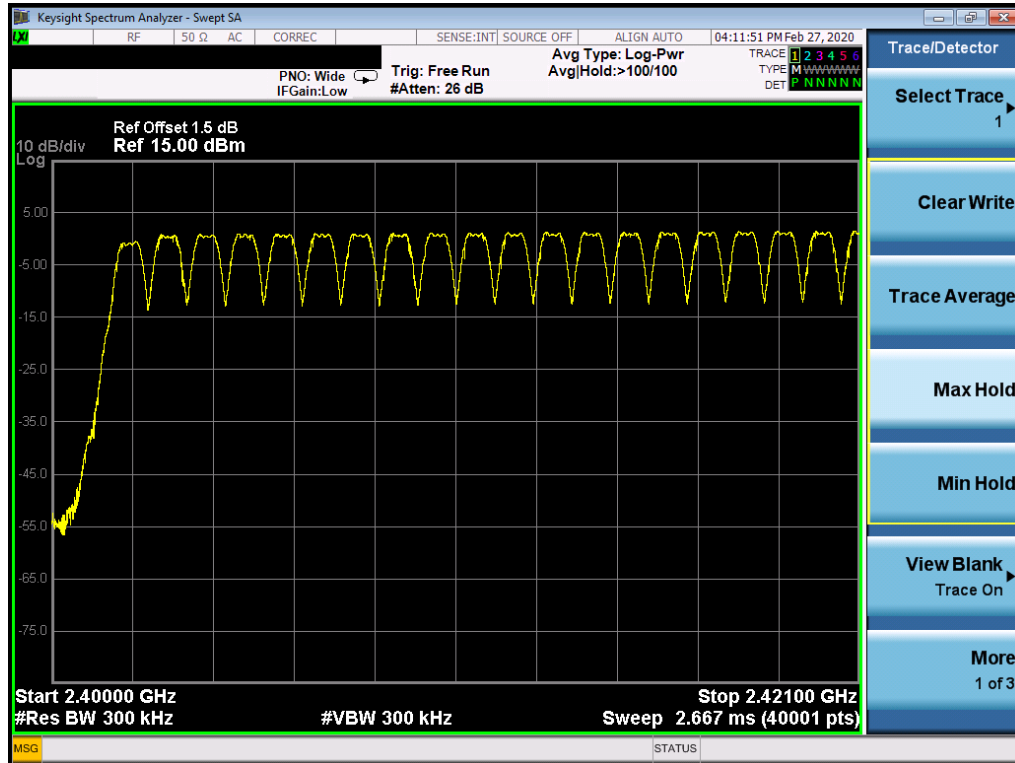


Figure 29: Number of Hopping Frequency, TM12, part 2

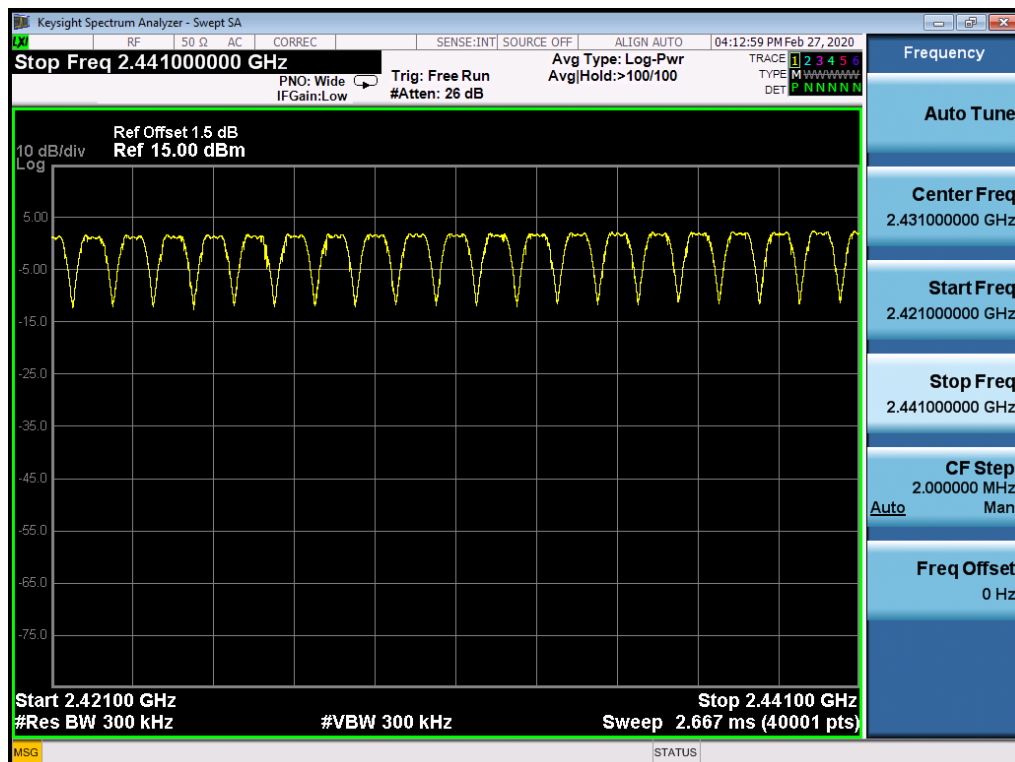


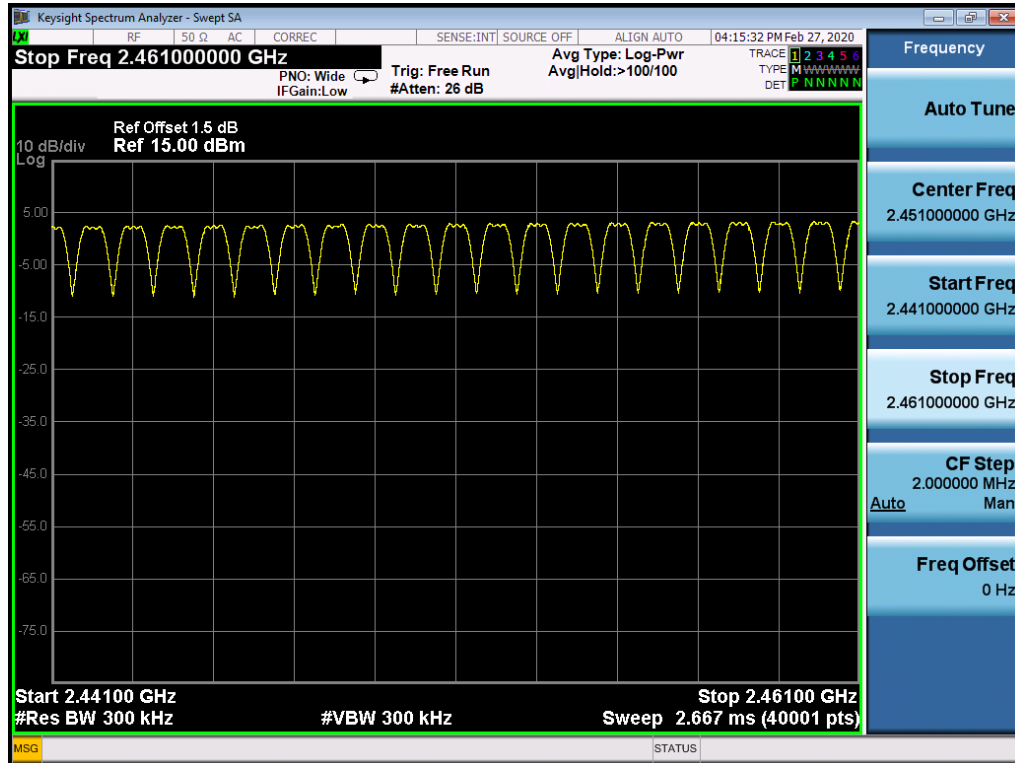
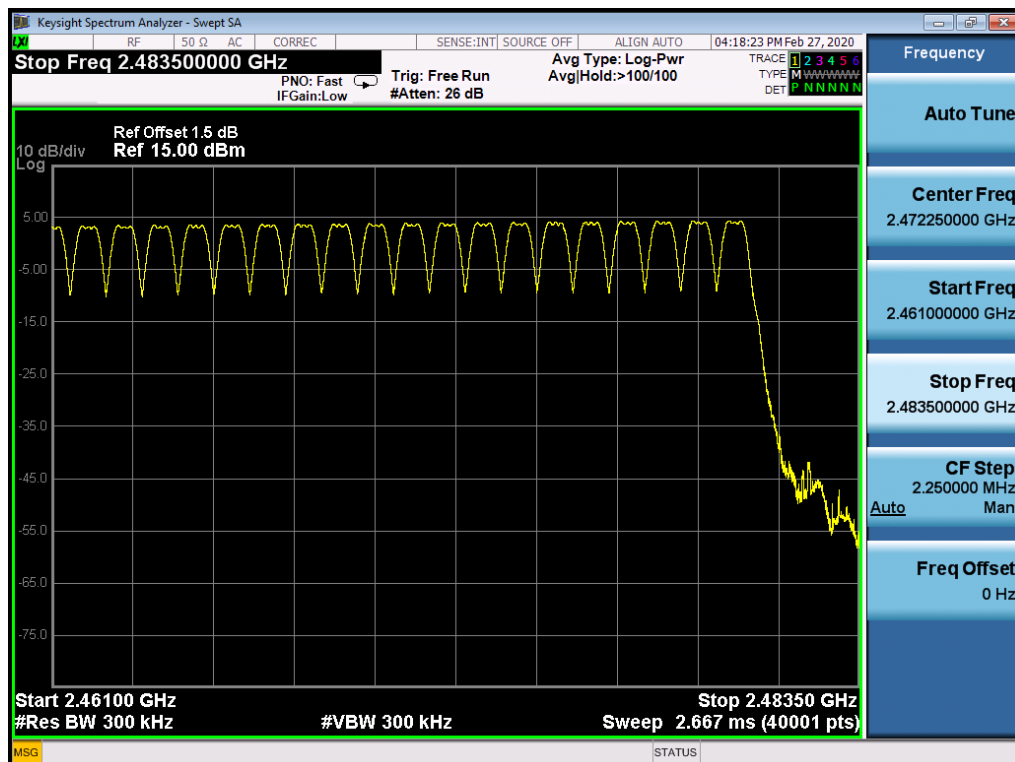
Figure 30: Number of Hopping Frequency, TM12, part 3

Figure 31: Number of Hopping Frequency, TM12, part 4


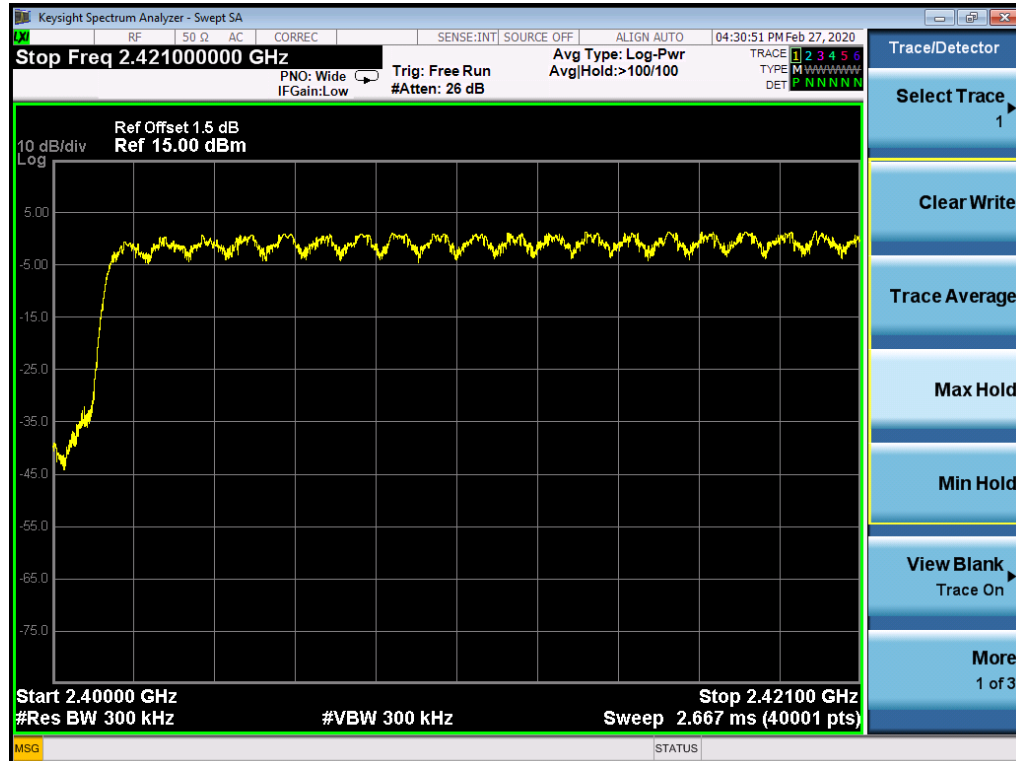
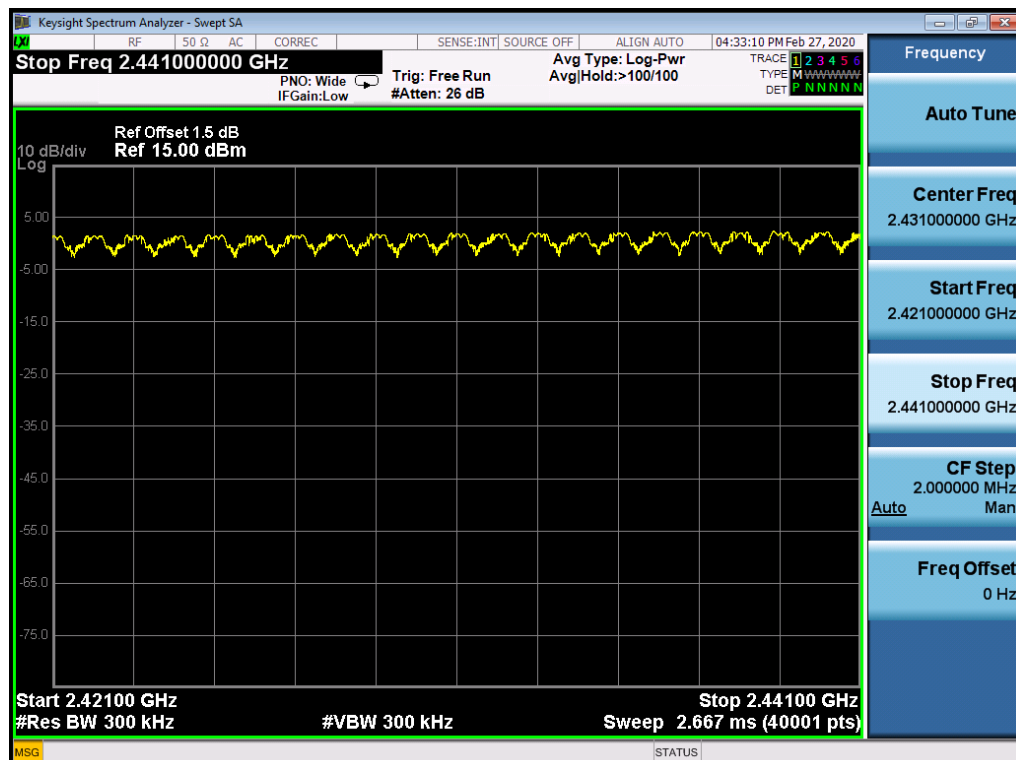
Figure 32: Number of Hopping Frequency, TM15, part 1

Figure 33: Number of Hopping Frequency, TM15, part 2


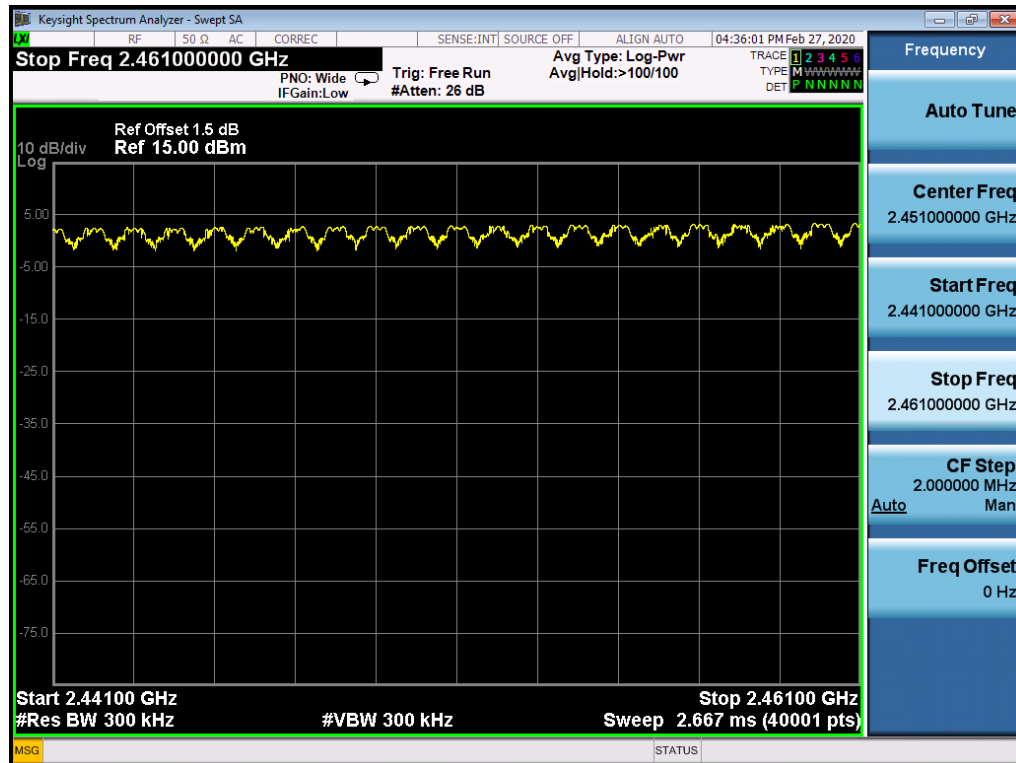
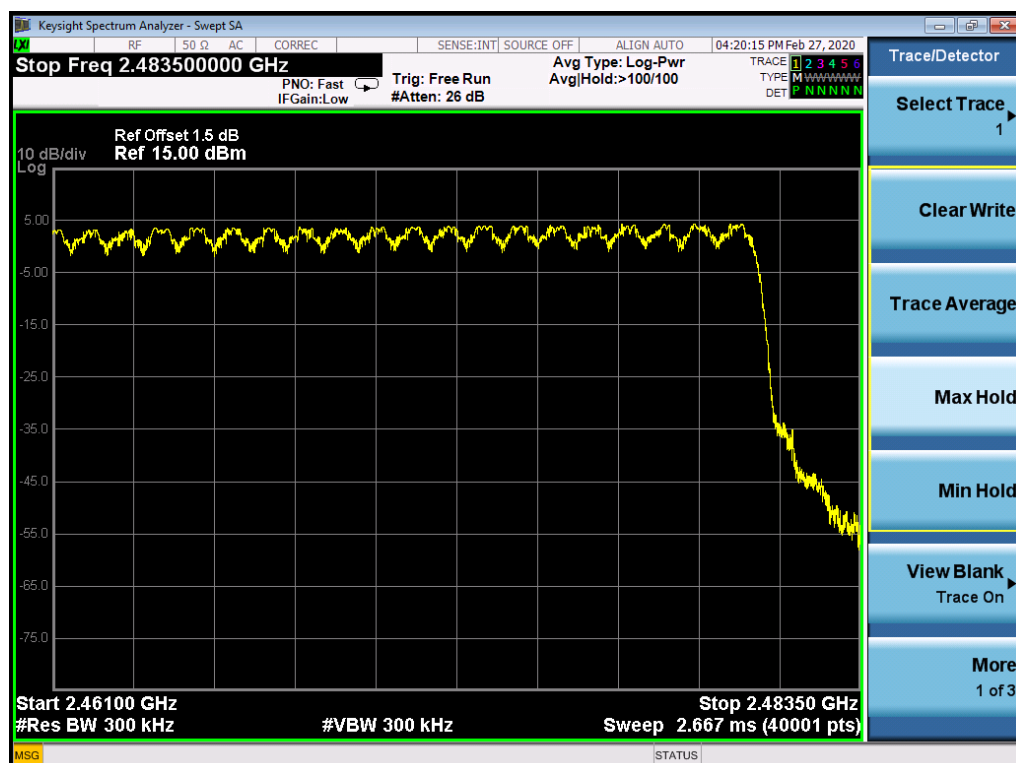
Figure 34: Number of Hopping Frequency, TM15, part 3

Figure 35: Number of Hopping Frequency, TM15, part 4


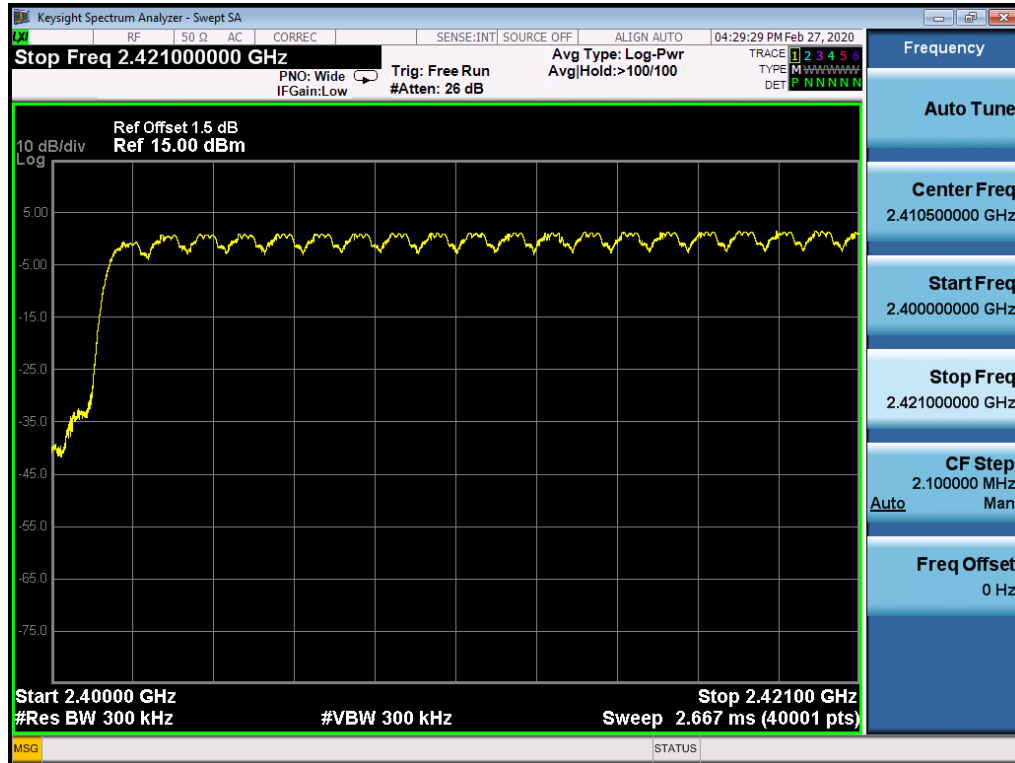
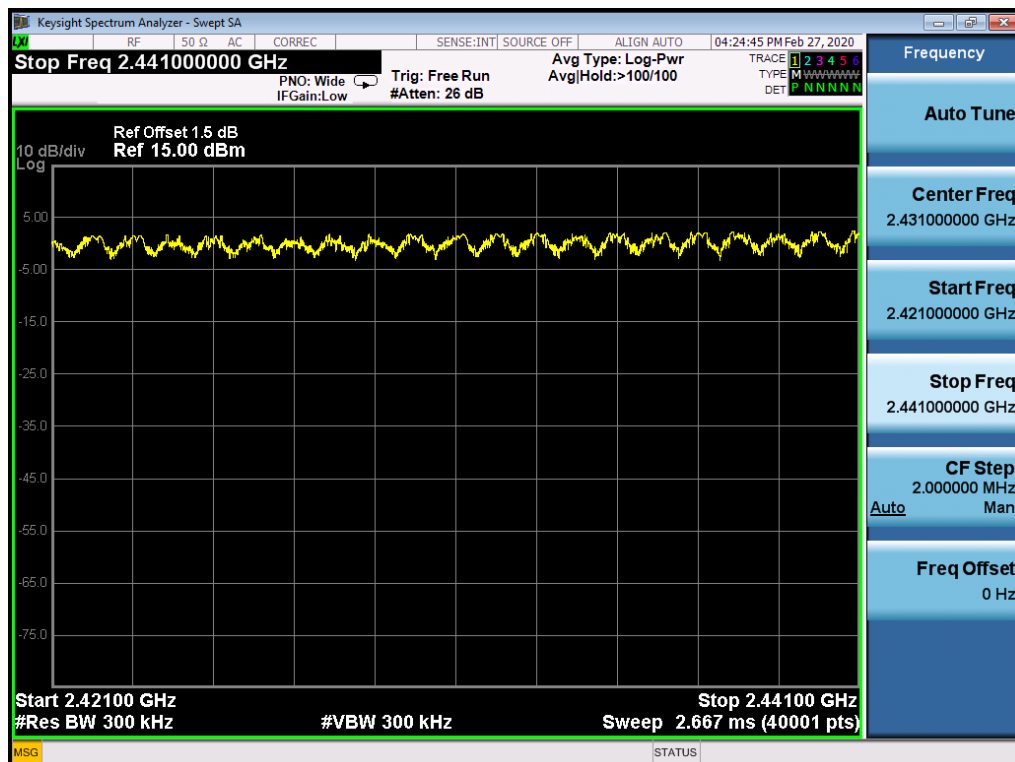
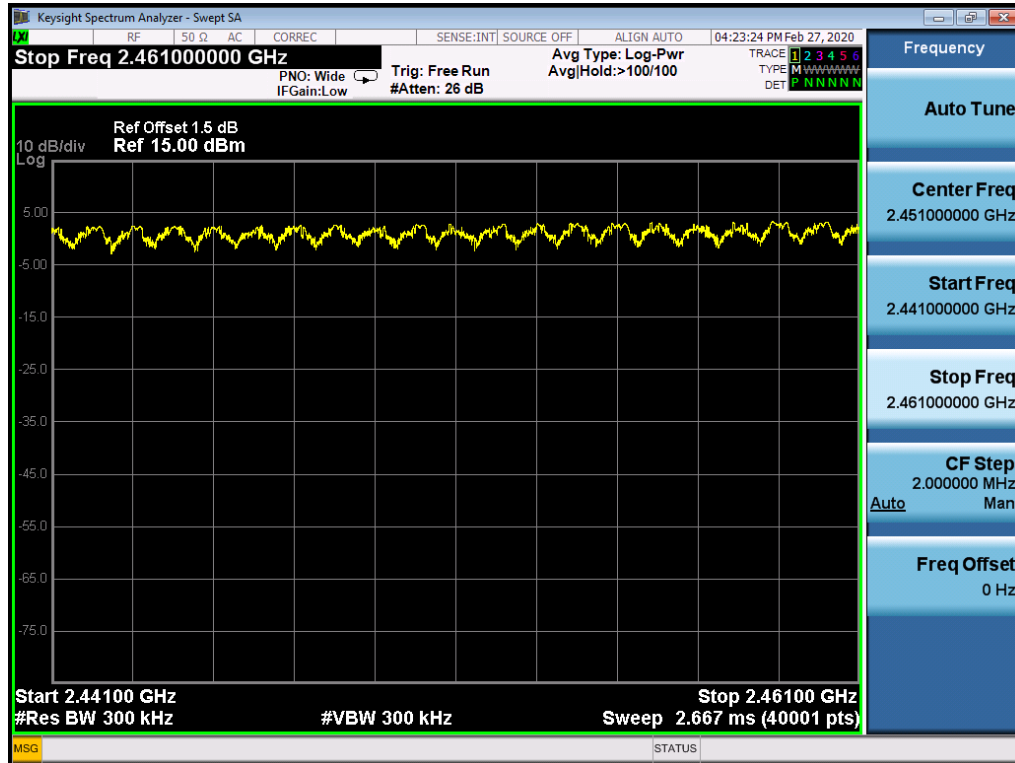
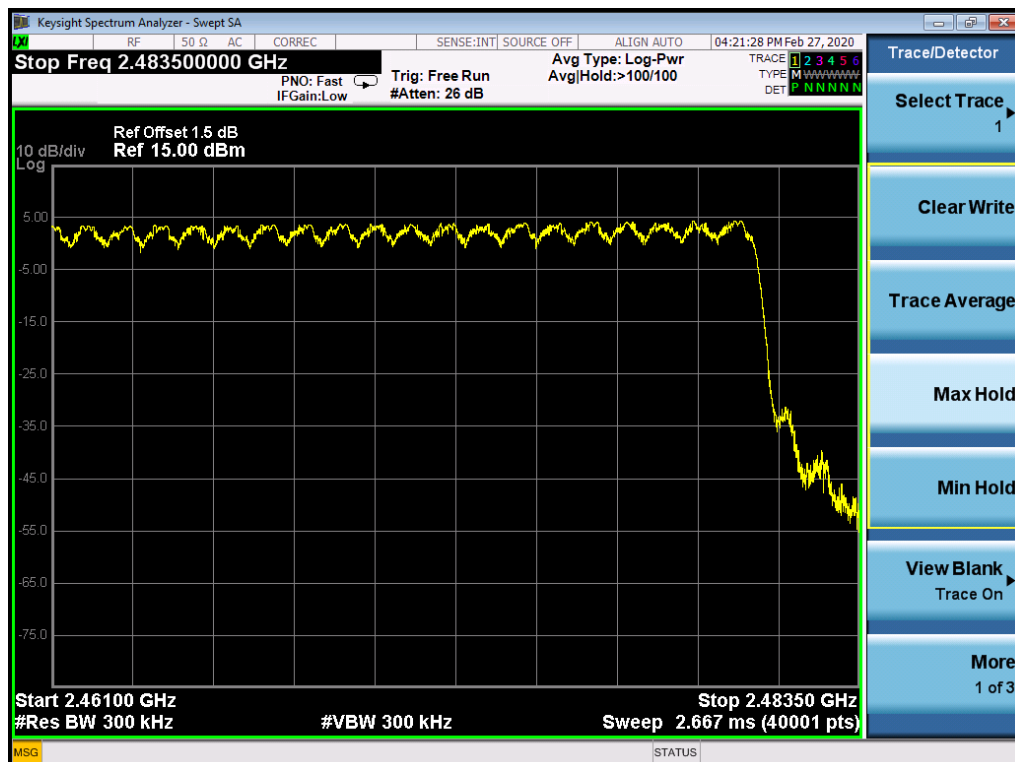
Figure 36: Number of Hopping Frequency, TM18, part 1

Figure 37: Number of Hopping Frequency, TM18, part 2


Figure 38: Number of Hopping Frequency, TM18, part 3

Figure 39: Number of Hopping Frequency, TM18, part 4


Hops Over Occupancy Time in 31.6s for DH5 = $1600 / 6 / 79 * 31.6 = 107$.

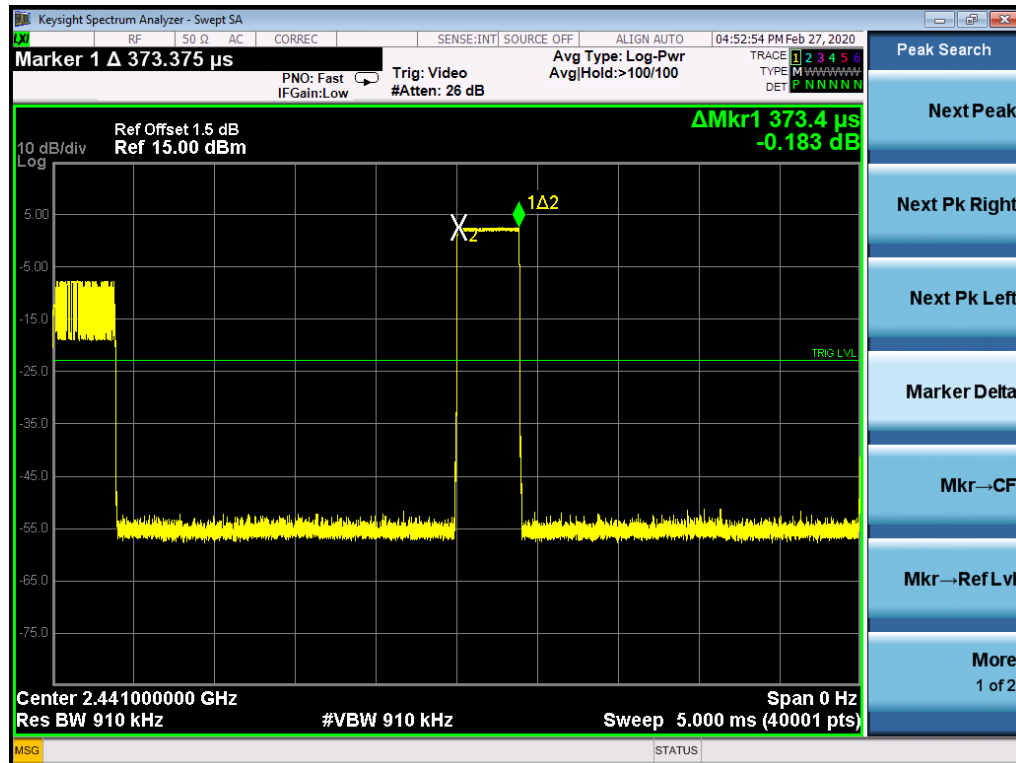
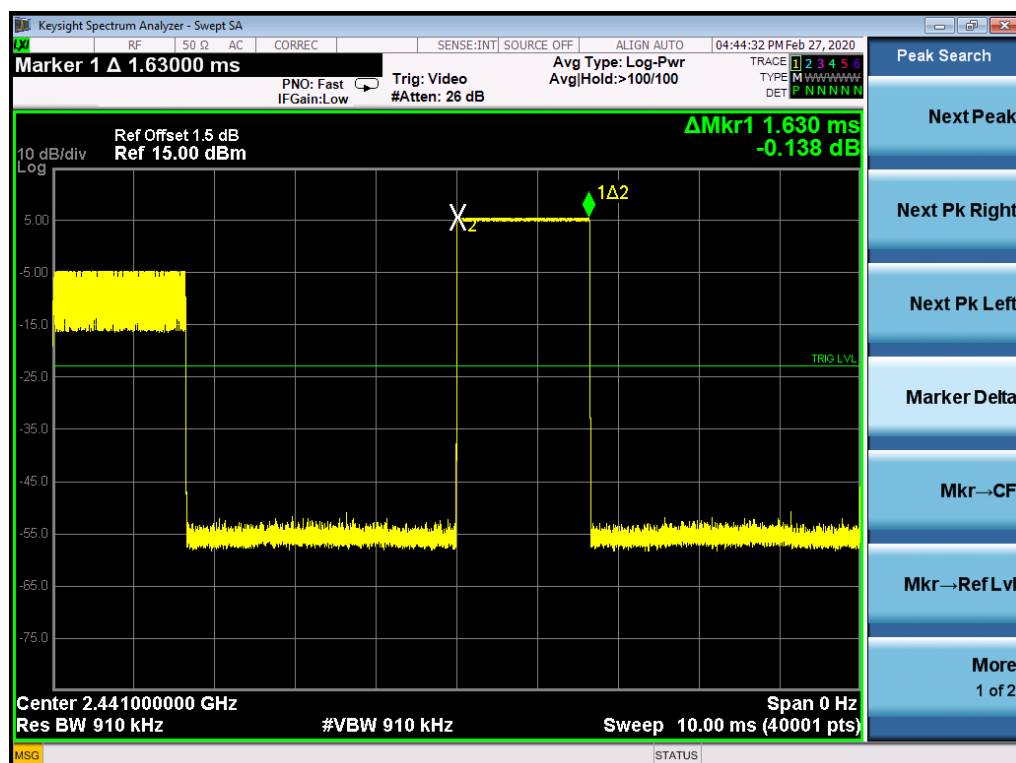
Figure 40: Time of Occupancy, TM10, observation Frequency 2441MHz

Figure 41: Time of Occupancy, TM11, observation Frequency 2441MHz


Figure 42: Time of Occupancy, TM12, observation Frequency 2441MHz

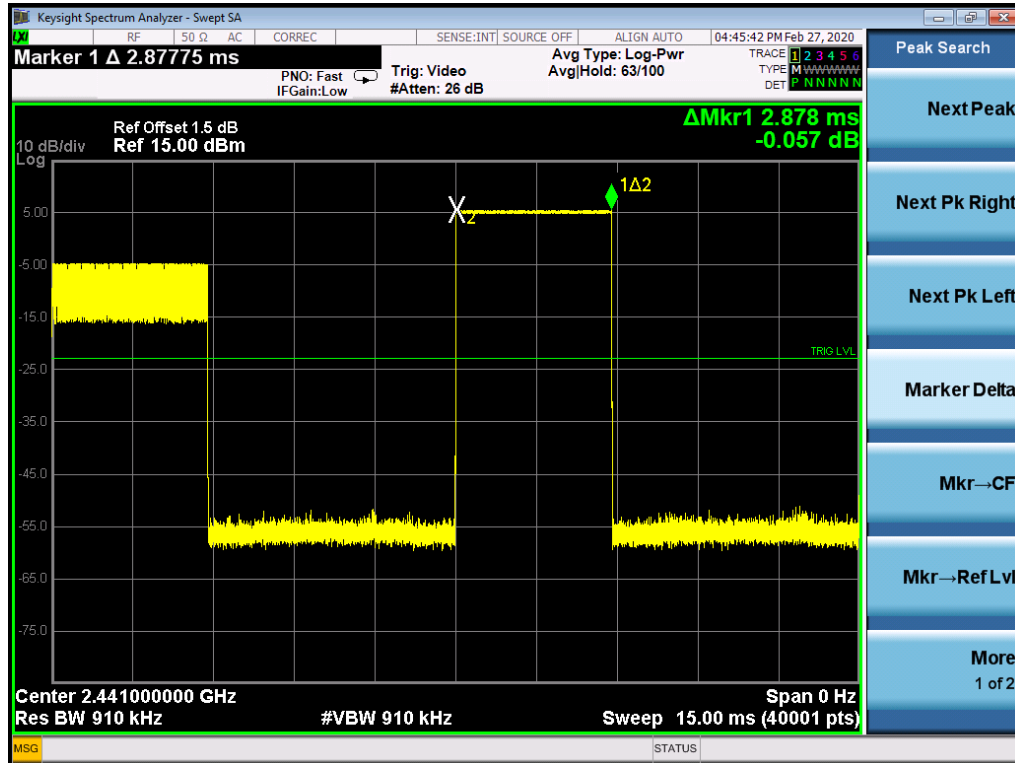


Figure 43: Time of Occupancy, TM13, observation Frequency 2441MHz

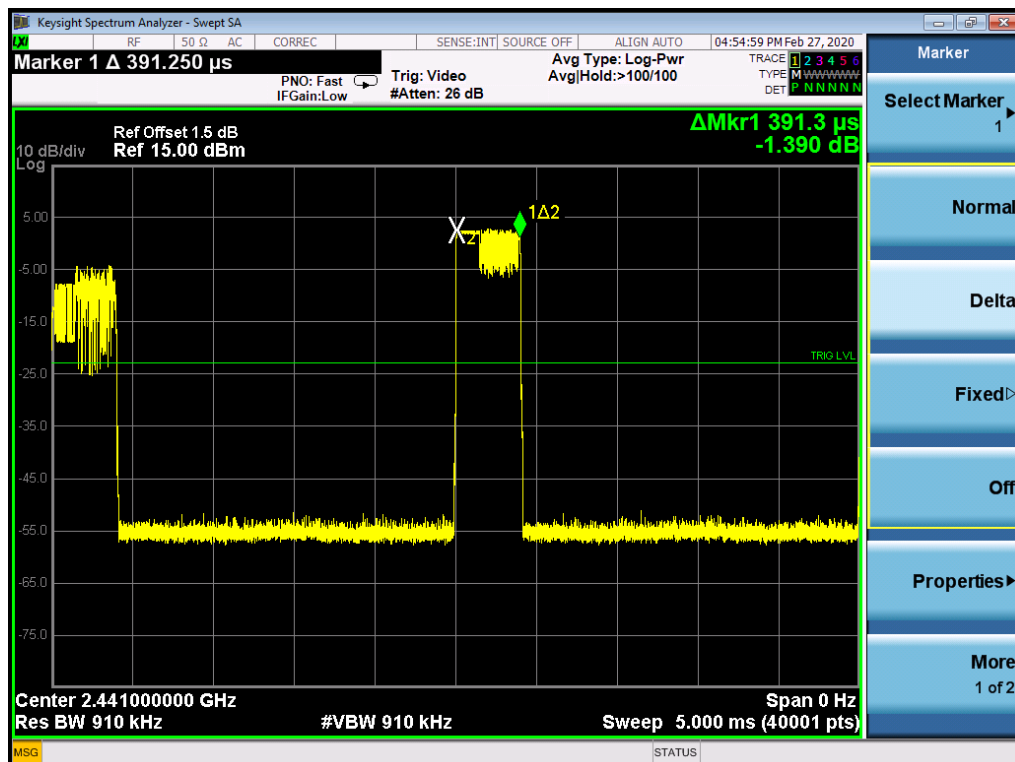


Figure 44: Time of Occupancy, TM14, observation Frequency 2441MHz

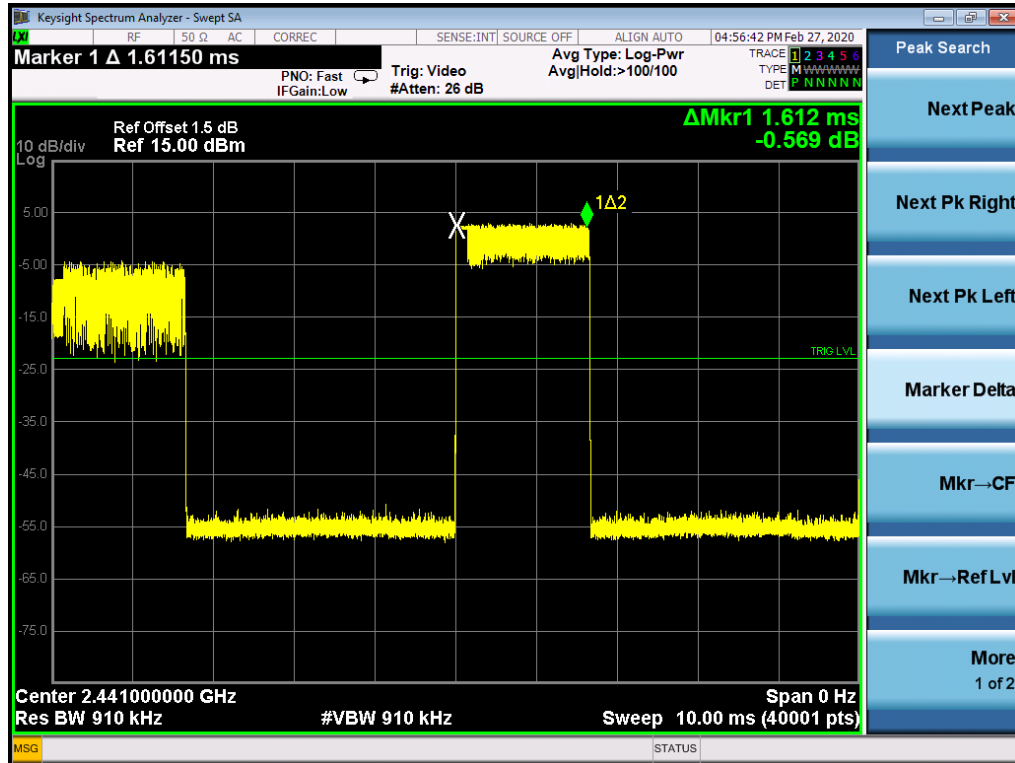


Figure 45: Time of Occupancy, TM15, observation Frequency 2441MHz

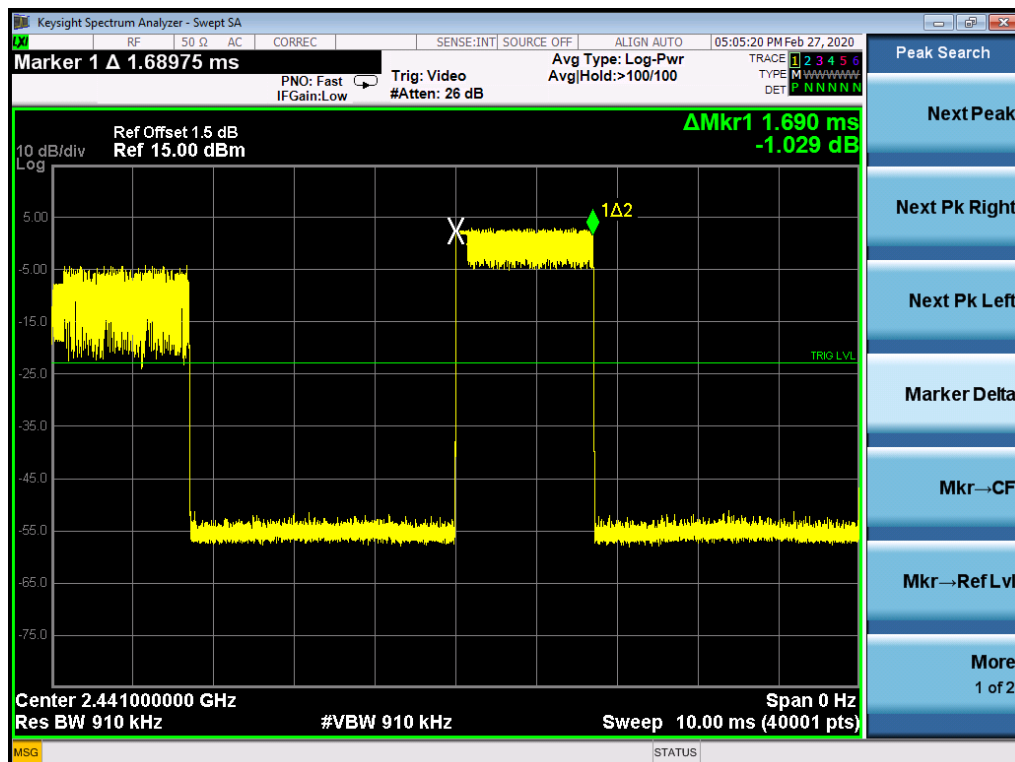


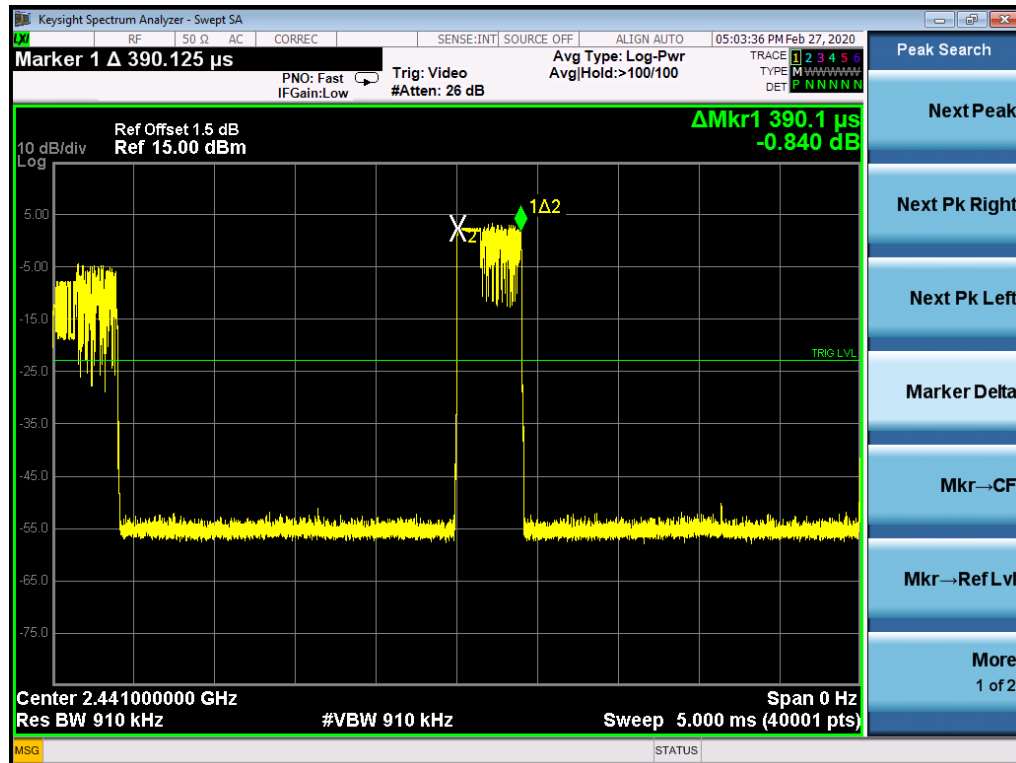
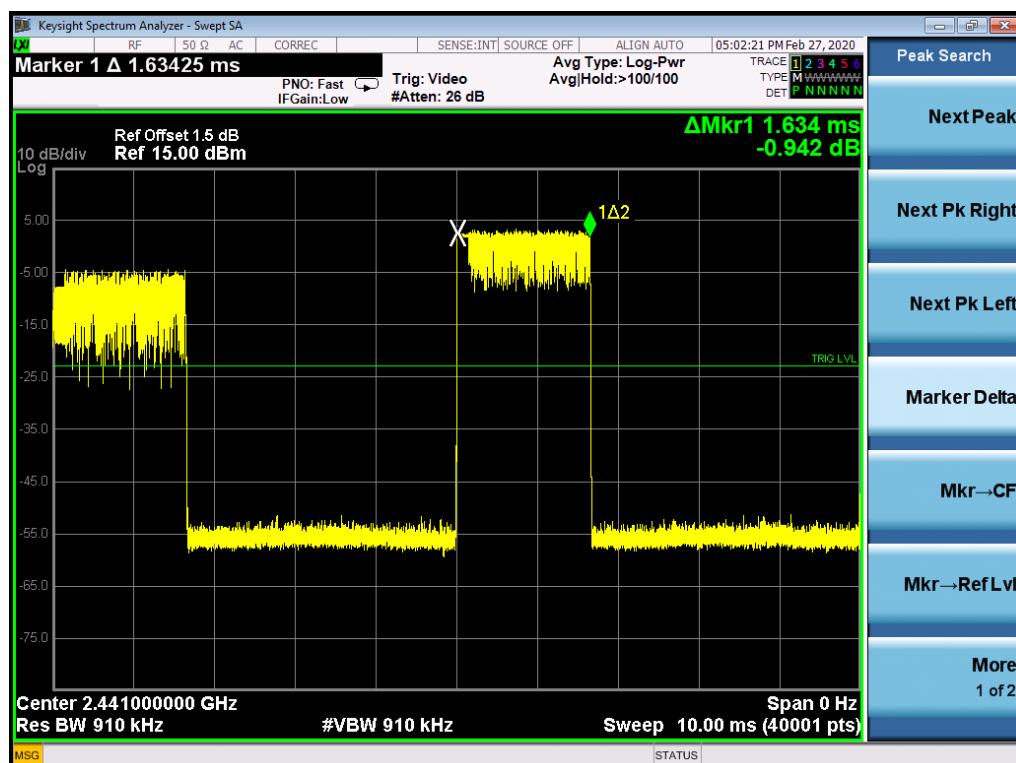
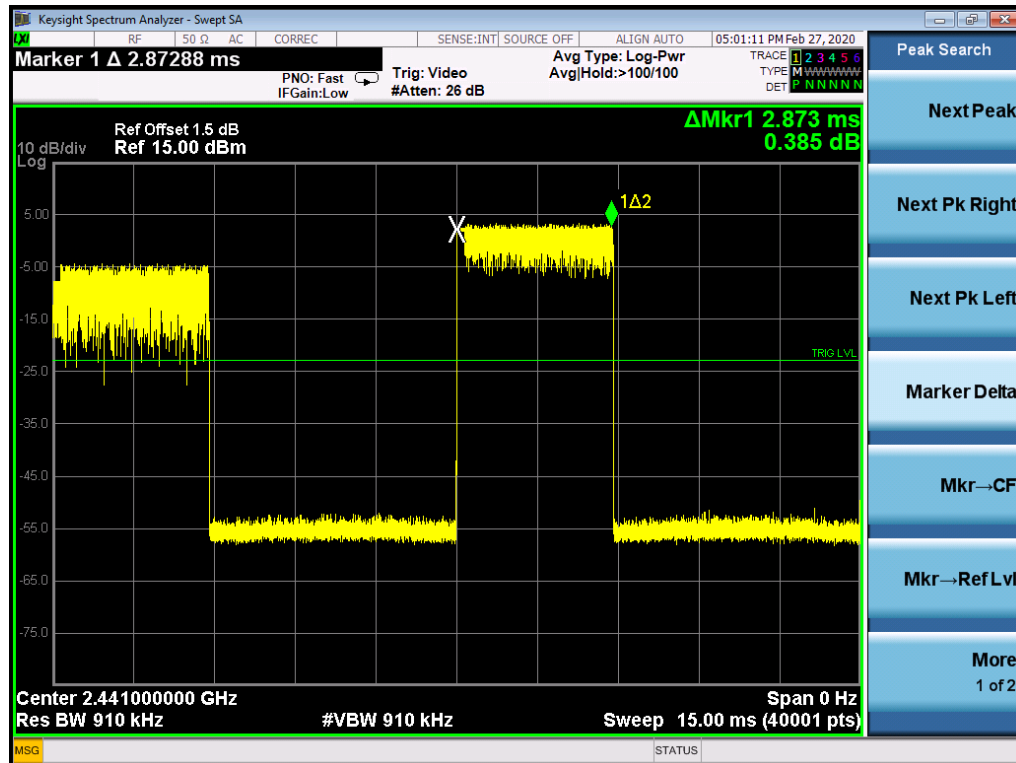
Figure 46: Time of Occupancy, TM16, observation Frequency 2441MHz

Figure 47: Time of Occupancy, TM17, observation Frequency 2441MHz


Figure 48: Time of Occupancy, TM18, observation Frequency 2441MHz


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5.1.7 Conducted Band-Edge

RESULT:**Pass**

Date of testing	:	27.02.2020
Ambient temperature	:	23.2°C
Relative humidity	:	45.7%
Atmospheric pressure	:	101kPa
Test requirement	:	FCC 15.247(d)
Test procedure	:	KDB 558074 D01v05r02 ANSI C63.10: 2013
Test voltage	:	DC 13V
Test modes applied	:	TM1, TM3, TM4, TM6, TM7, TM9, TM12, TM15, TM18

Figure 49: Conducted Band-Edge, TM1

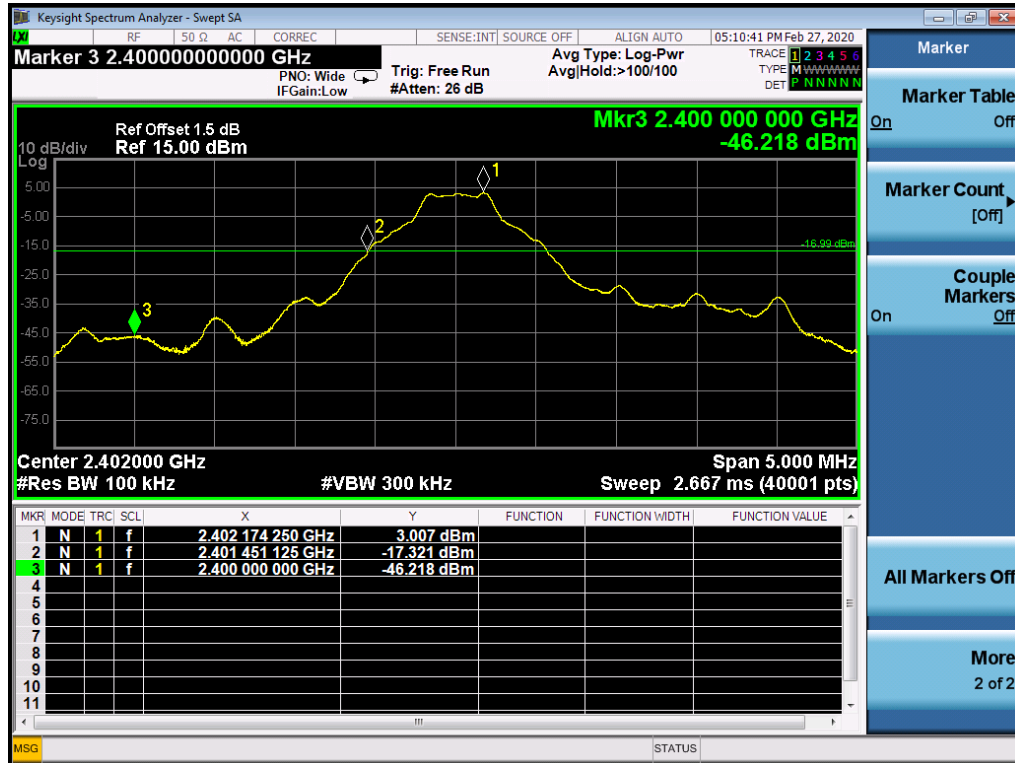


Figure 50: Conducted Band-Edge, TM3



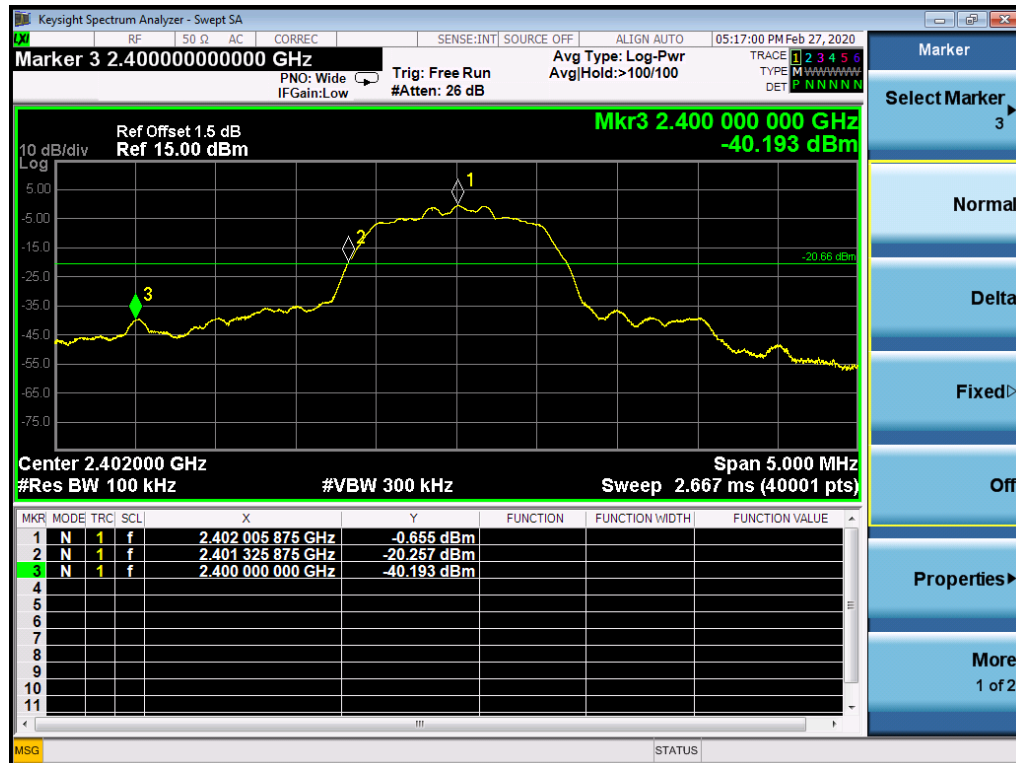
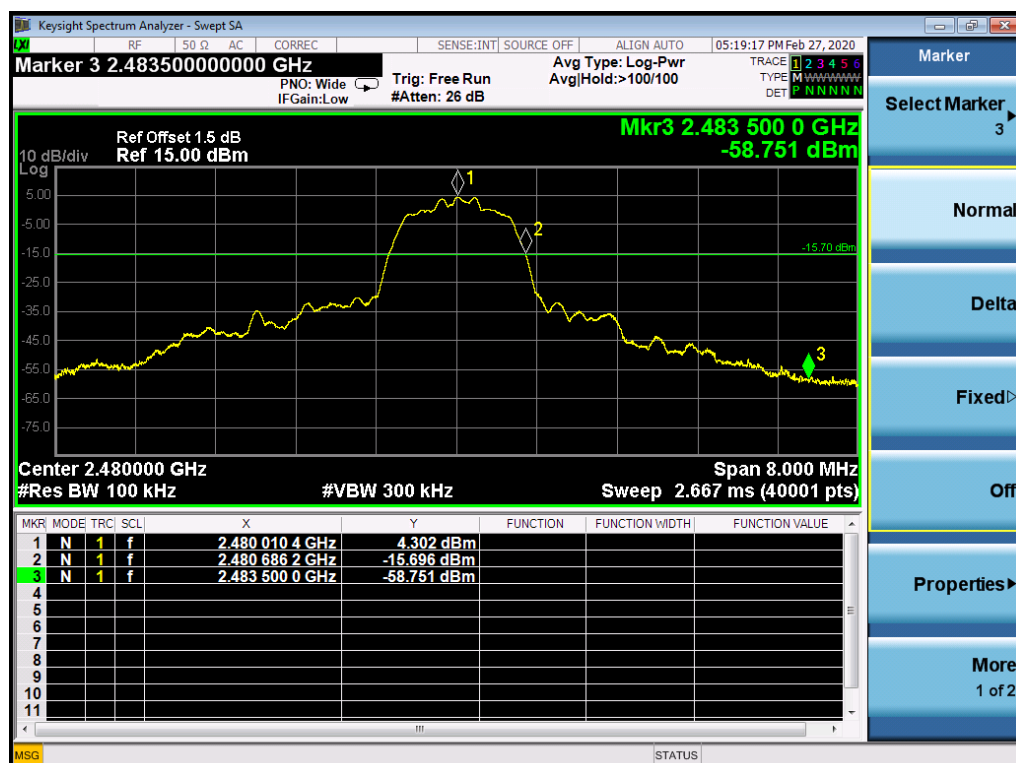
Figure 51: Conducted Band-Edge, TM4

Figure 52: Conducted Band-Edge, TM6


Figure 53: Conducted Band-Edge, TM7

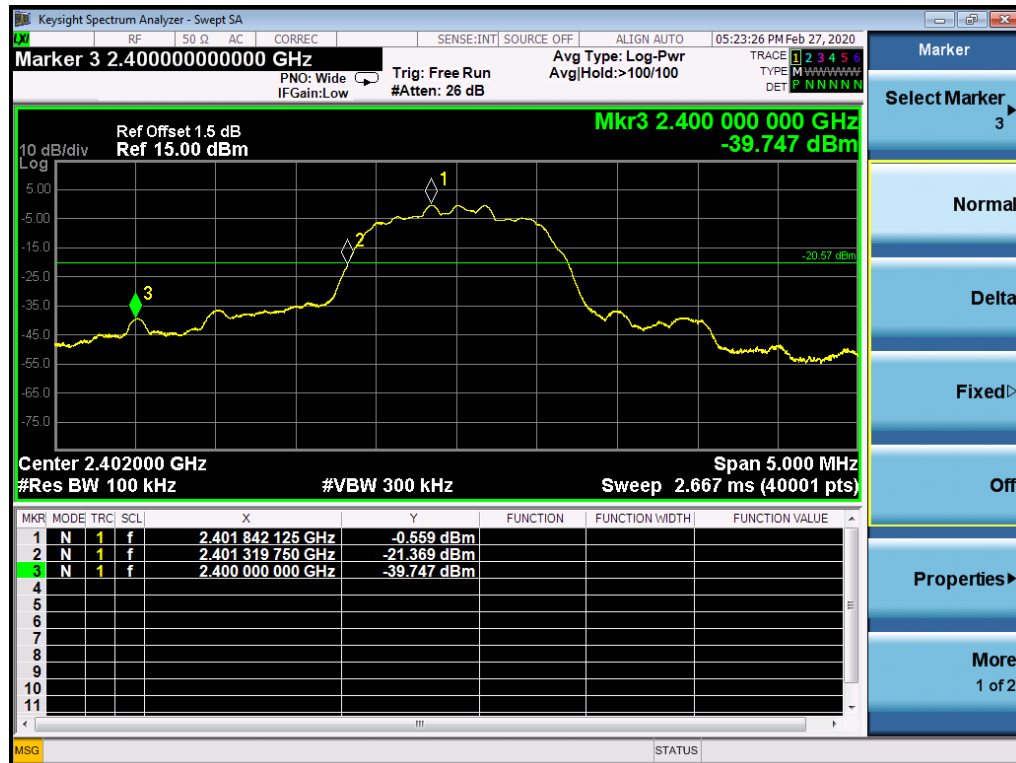


Figure 54: Conducted Band-Edge, TM9

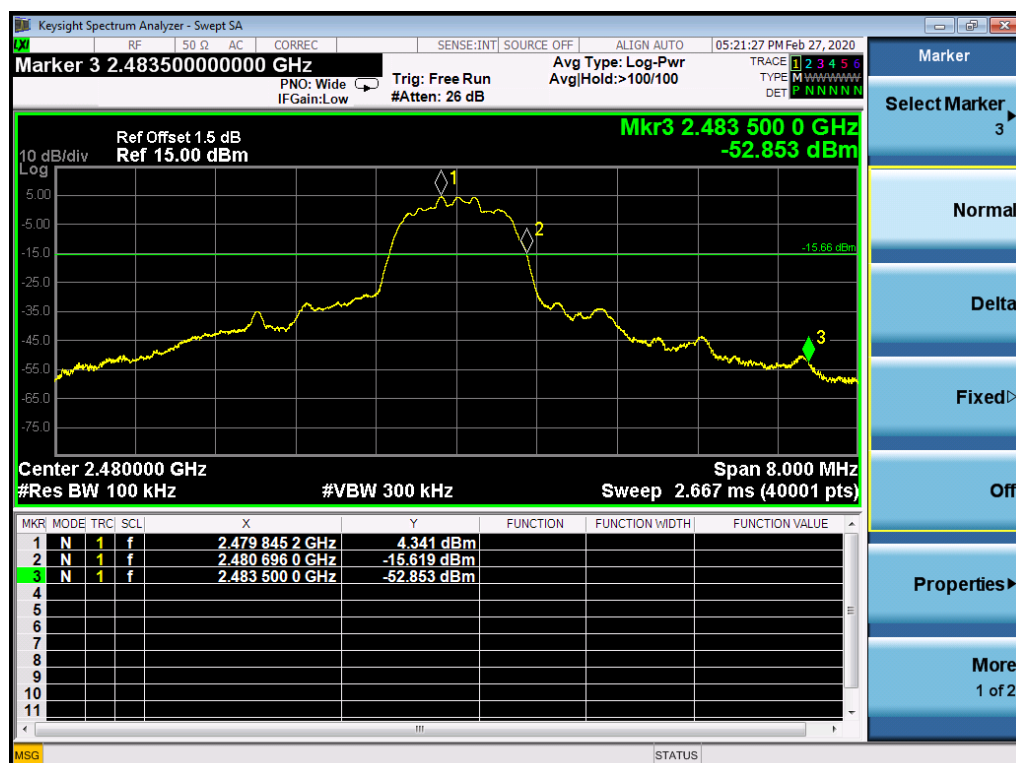


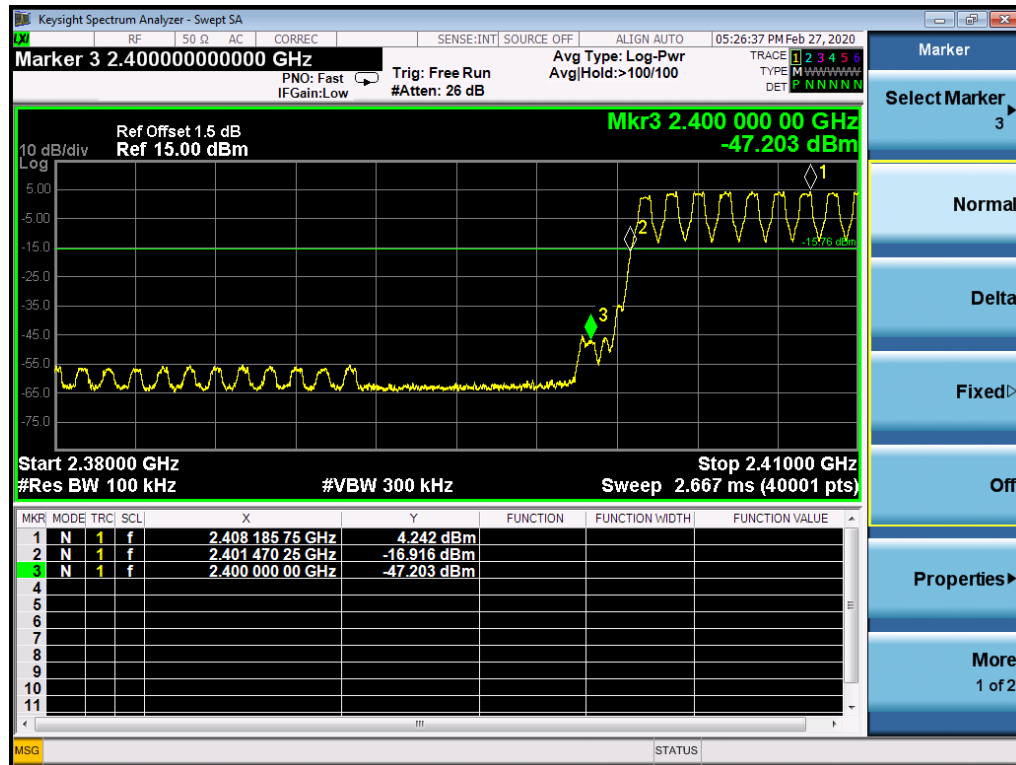
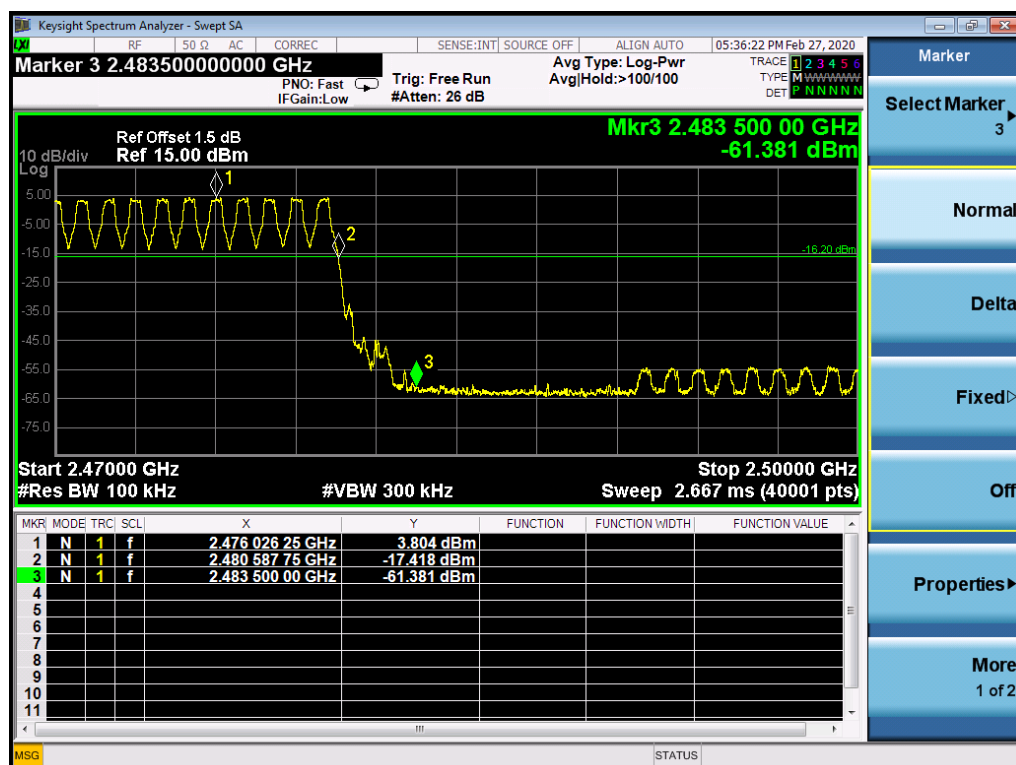
Figure 55: Conducted Band-Edge, TM12 lower band

Figure 56: Conducted Band-Edge, TM12, higher band


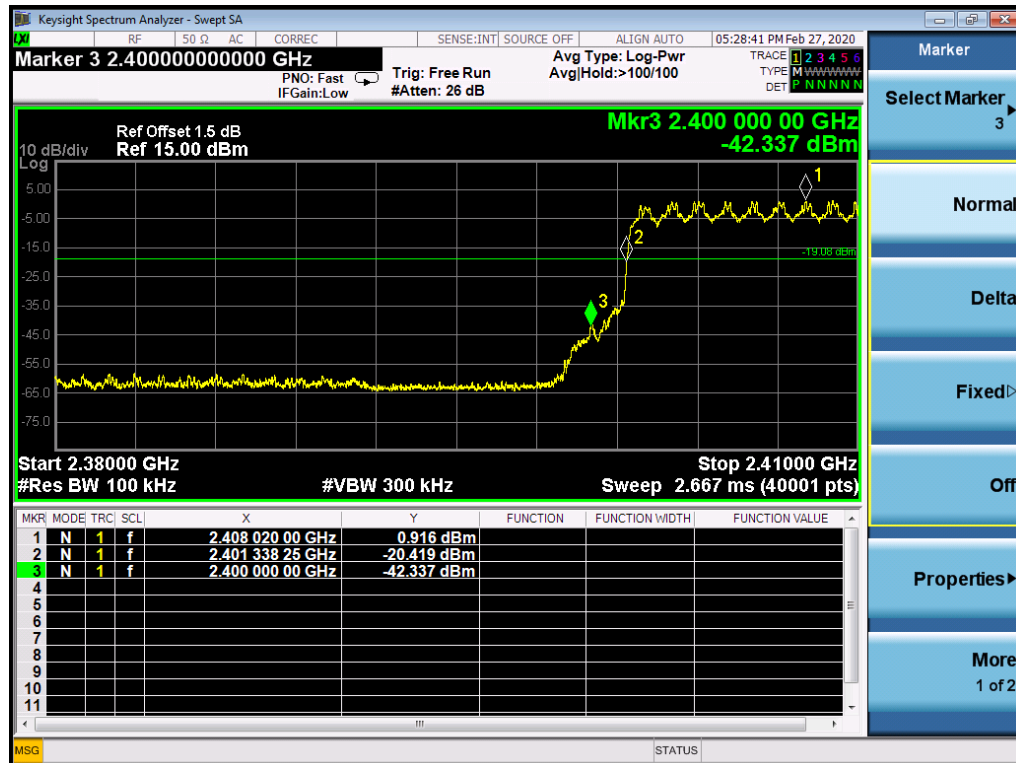
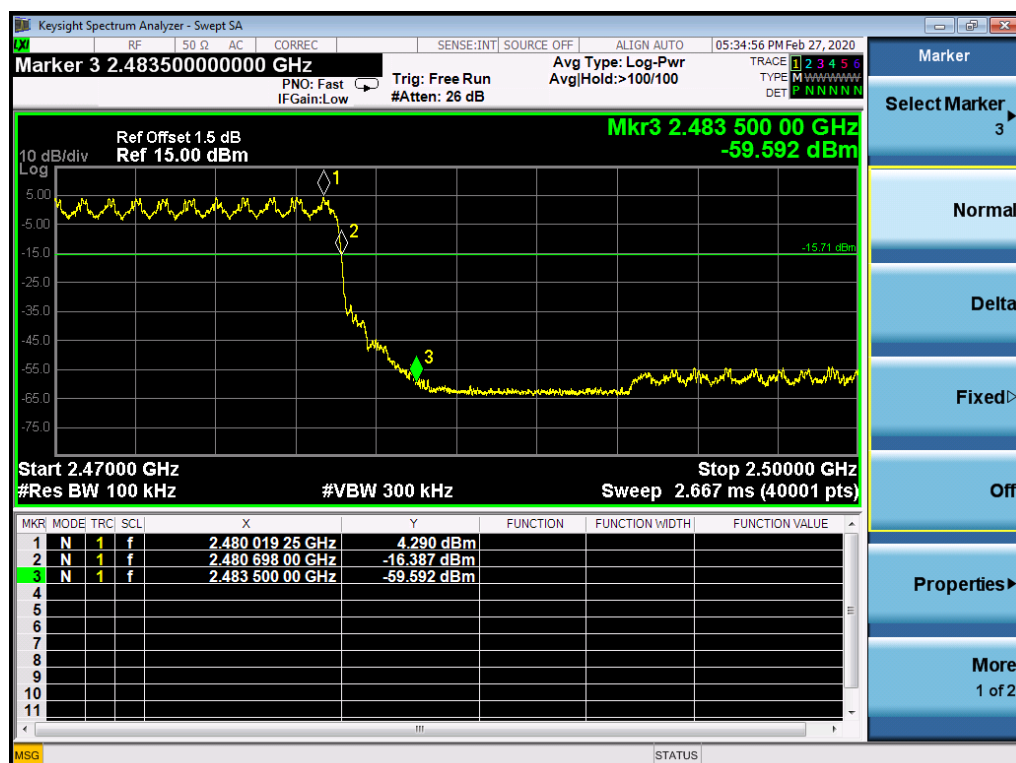
Figure 57: Conducted Band-Edge, TM15, lower band

Figure 58: Conducted Band-Edge, TM15, higher band


Figure 59: Conducted Band-Edge, TM18, lower band

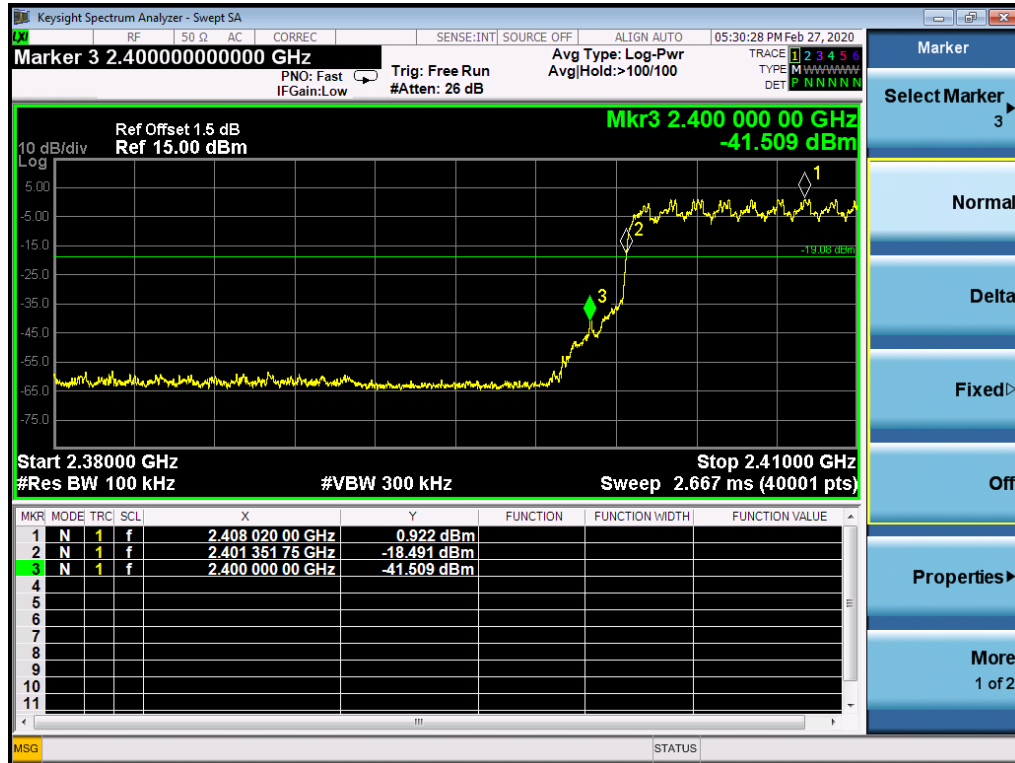
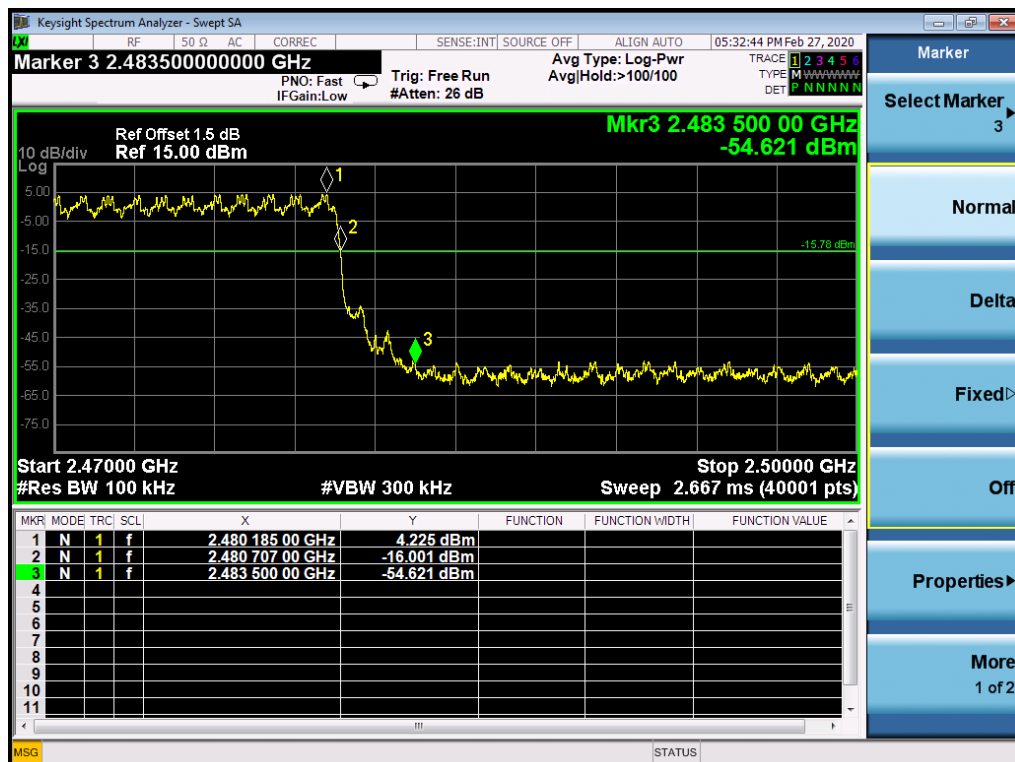


Figure 60: Conducted Band-Edge, TM18, higher band



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5.1.8 Conducted Spurious Emissions

RESULT:**Pass**

Date of testing	:	27.02.2020
Ambient temperature	:	23.2°C
Relative humidity	:	45.7%
Atmospheric pressure	:	101kPa
Test requirement	:	FCC 15.247(d)
Test procedure	:	KDB 558074 D01v05r02 ANSI C63.10: 2013
Test voltage	:	DC 13V
Test modes applied	:	TM1 to TM9

Figure 61: Conducted Spurious Emission, TM1

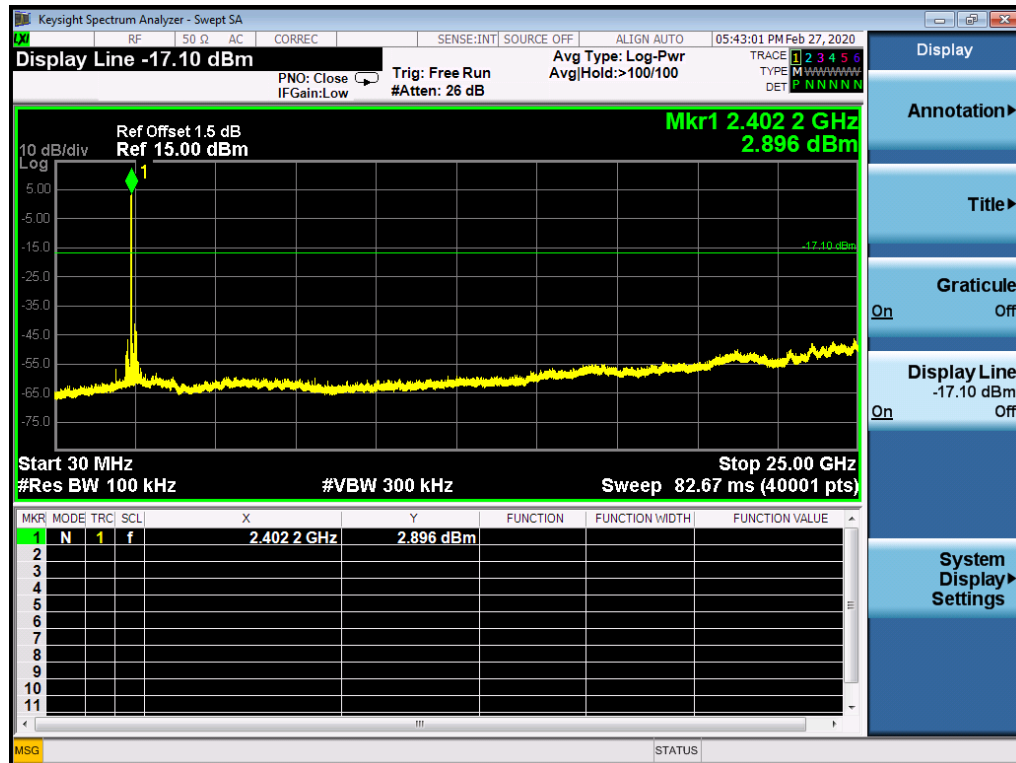


Figure 62: Conducted Spurious Emission, TM2

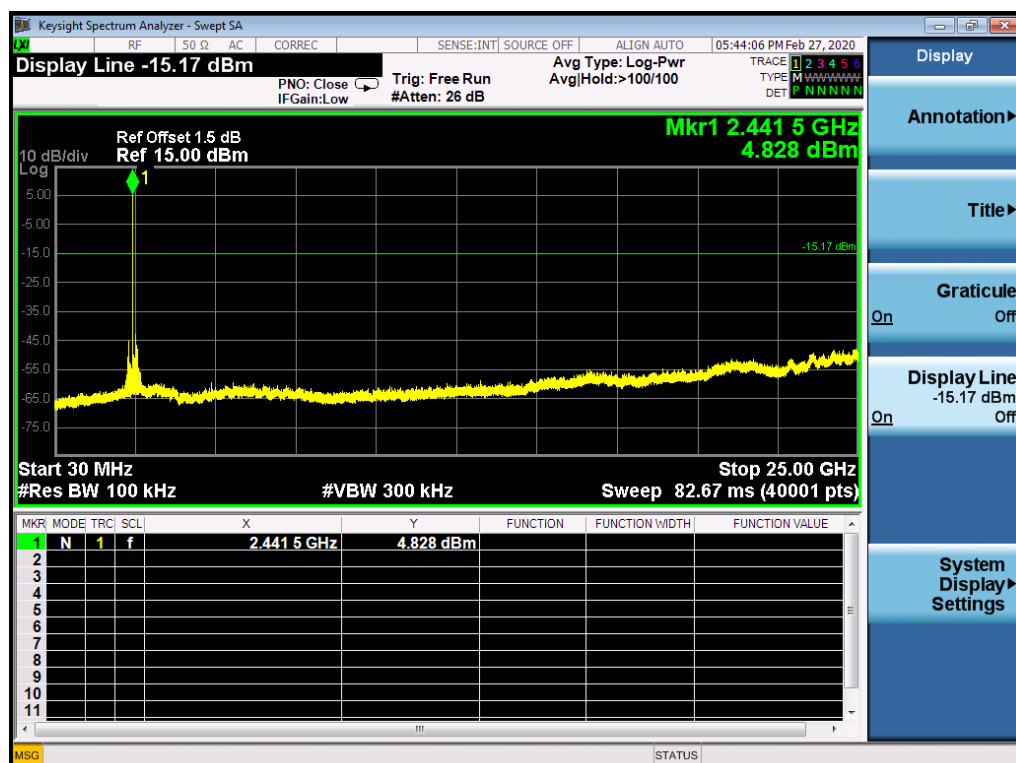


Figure 63: Conducted Spurious Emission, TM3

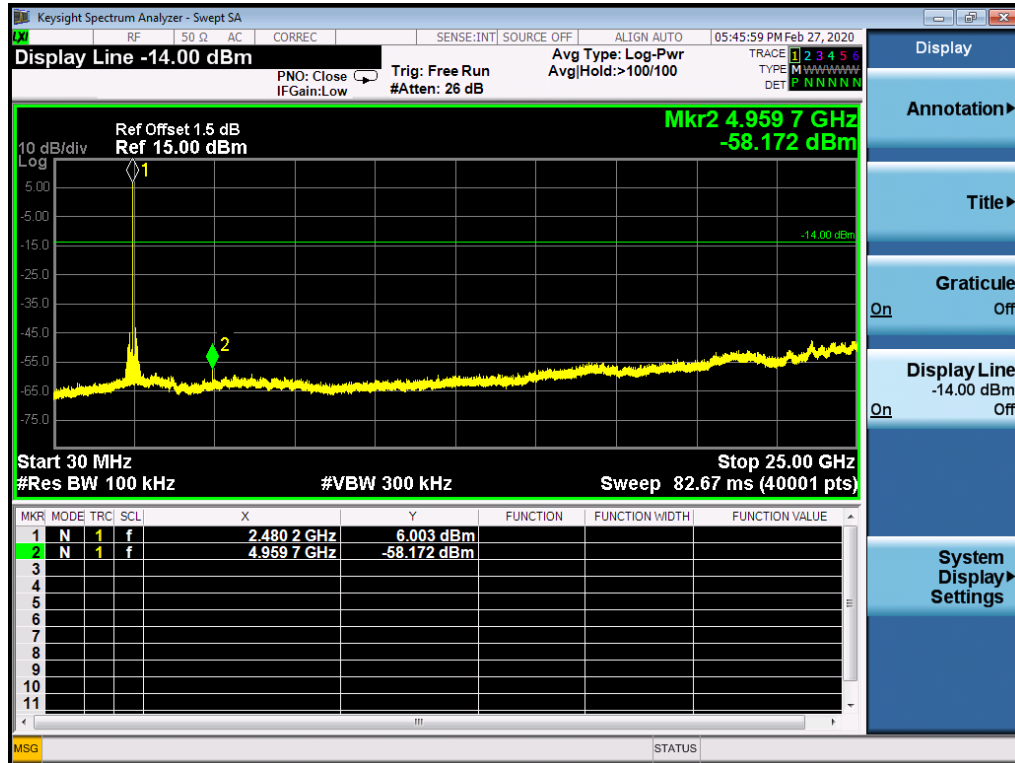


Figure 64: Conducted Spurious Emission, TM4

