FCC PART 90 Test Report

for RF DATA RADIO

Product Name : GNSS receiver
Model Name : i80 WXYZ

Prepared for:
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Report Number : UL41320150312CE/FCC002-3
Date of Report : 07-30-2015
Date of Test : 06-08-2015~07-30-2015

Notes：
The test results only relate to these samples which have been tested.
Partly using this report will not be admitted unless been allowed by Unilab.
Uniab is only responsible for the complete report with the reported stamp of Unilab.

Applicant:	Shanghai Huace Navigation Technology LTD. Building C,599 Gaojing Road,Qingpu District,Shanghai
Manufacturer:	Shanghai Huace Navigation Technology LTD. Building C,599 Gaojing Road,Qingpu District,Shanghai
Product Name:	GNSS receiver
Brand Name:	
Model Name:	i80 WXYZ
Model Description:	See Part1.1 Note.
FCC ID:	SY4-A01004
Serial Number:	N/A
EUT Voltage:	MIN: 8V, NOR:12V, MAX: 36V
Date of Receipt:	03-12-2015
Test Standard:	ANSI/TIA-603-D-2010; FCC CFR Title 47 Part 2 FCC CFR Title 47 Part 90 Subpart I; ANSI C63.4: 2009
Test Result:	PASS
Date of Test:	06-08-2015~07-30-2015

Tested by : Jeffrey.wang
(Test Engineer: Jeffrey Wang)

Reviewed by : Forest Cao
(Senior Engineer: Forest Cao)

Approved by : Eva wang
(Supervisor: Eva Wang)

TABLE OF CONTENTS

1. GENERAL INFORMATION

1.1 EUT DESCRIPTION

Product Name:	GNSS receiver
Model Name:	i80 WXYZ
Hardware Version:	V1.3
Software Version:	V1.1.8
RF Exposure Environment:	Uncontrolled
Radio	
Operating Frequency band:	403MHz to 406MHz 406.1MHz to 473MHz
Channel Separation	12.5KHz, 25.0 KHz
Type of modulation:	4FSK, GMSK
Antenna Type:	Detachable
Antenna Peak Gain:	3.0dBi
Component	
AC Adapter	Input: AC 100-240V 50/60Hz
	Output: DC 12V 2A

Note: Model i80 WXYZ, W is variable, it indicated A-Z or 0-9 or blank，X is variable, it indicated A-Z or 0-9 or blank，Y is variable, it indicated A-Z, 0-9 or blank. Z is variable, it indicated A-Z, 0-9 or blank. due to sales purpose in different countries or regions. The internal PCB design are no difference，but only distinct in colours and model names. This test model name is i80.

1.2 TEST MODE

Unilab has verified the construction and function in typical operation. All the test modes were carried out with the EUT in normal operation, which was shown in this test report and defined as:

Test Mode
Mode 1: 4FSK, 12.5 KHz bandwidth
Mode 2: 4FSK, 25 KHz bandwidth
Mode 3: GMSK, 12.5 KHz bandwidth
Mode 4: GMSK, 25 KHz bandwidth

Note:
1. Regards to the frequency band operation: the lowest, middle and highest frequency of channel were selected to perform the test, then shown on this report.
2. For the radiated emission test, every axis (X, Y, Z) was verified, and show the worst result on this report.

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4: 2009, ANSI/TIA-603-D-2010 and FCC CFR 47 2.1046, 2.1047, 2.1049, 2.1051, 2.1053, 2.1055, 2.1057.

2.1 EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application

2.2 EUT EXERCISE

The EUT has been programmed to continuously transmit or receive during testing. The used peripherals as well as the configuration fulfill the requirements of ANSI C63.4:2009.

2.3 GENERAL TEST PROCEDURES

Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 13.1.4.1 of ANSI C63.4: 2009 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the maximum emissions, exploratory radiated emission measurements were made according to the requirements in Section 13.1.4.1 of ANSI C63.4: 2009.

2.4 DESCRIPTION OF TEST MODES

The EUT has been tested under operating condition.
Three channels (403MHz, 450MHz and 473MHz) are chose for testing at each channel separation (12.5 KHz, 25.0 KHz), and each modulation (4FSK, GMSK).

3. TECHNIACL SUMMARY

3.1 SUMMARY OF STANDARDS AND TEST RESULTS

The EUT have been tested according to the applicable standards as referenced below:

Test Item	FCC	Result
RF Power Output	§2.1046 (a), §90.205	Pass
Transmitter Spurious Conducted Emissions	§2.1051, §90.210	Pass
Field Strength of Spurious Radiation	§2.1053(a), §90.210	Pass
Emission Masks	§90.210	Pass
Occupied Bandwidth	§2.1049(c)(1), §90.209	Pass
Frequency Stability vs. Temperature and Voltage	§2.1055, §90.213	Pass
Transient Frequency Behavior	§90.214	Pass
Modulation Characteristics	§2.1047 (a)(b)	NA(note)

Note: The EUT is digital; no audio function and audio filtering present therefore testing not required.

3.2 TEST UNCERTAINTY

Where relevant, the following test uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Test item	Value (dB)
Conducted disturbance	3.4
Radiated disturbance	4.2

3.3 TEST EQUIPMENT LIST

Equipment	Manufacturer	Model	Serial No.	Cal. Interval	Due Date
Receiver	Agilent	N9038A	MY51210142	1 year	11/11/2015
Signal Generator	R&S	SMR40	100116	1 year	11/11/2015
Attenuator	CDS	ATT-20	/	1 year	11/11/2015
Oscilloscope	Lecroy	WAVERUNNER 6100A	LCRY0604P14508	1 year	02/27/2016
3m Chamber & Accessory Equipment	ETS-LINDGREN	FACT-3	CT-0000336	3 years	11/26/2017
Microwave Preamplifier	EM Electronics	EM30180	3008A02425	1 year	02/27/2016
Power Splitter	Agilent	11667C/ 52401	MY53806148	1 year	02/27/2016
Biconilog Antenna	Schwarzbeck	VULB 9160	3316	3 years	09/19/2016
Horn Antenna	Schwarzbeck	BBHA9120D	942	3 years	09/19/2016
Horn Antenna	Schwarzbeck	BBHA9120D	943	3 years	09/19/2016
Loop Antenna	Schwarzbeck	FMZB1519	1519-020	3 years	03/25/2016

3.4 TEST FACILITY

All test facilities used to collect the test data are located at No.1350, Lianxi Rd. Pudong New District, Shanghai, China. The site and apparatus are constructed in conformance with the requirements of ANSI C63.4: 2009, CISPR 16-1-1 and other equivalent standards. The laboratory is compliance with the requirements of the ISO/IEC/E 17025.

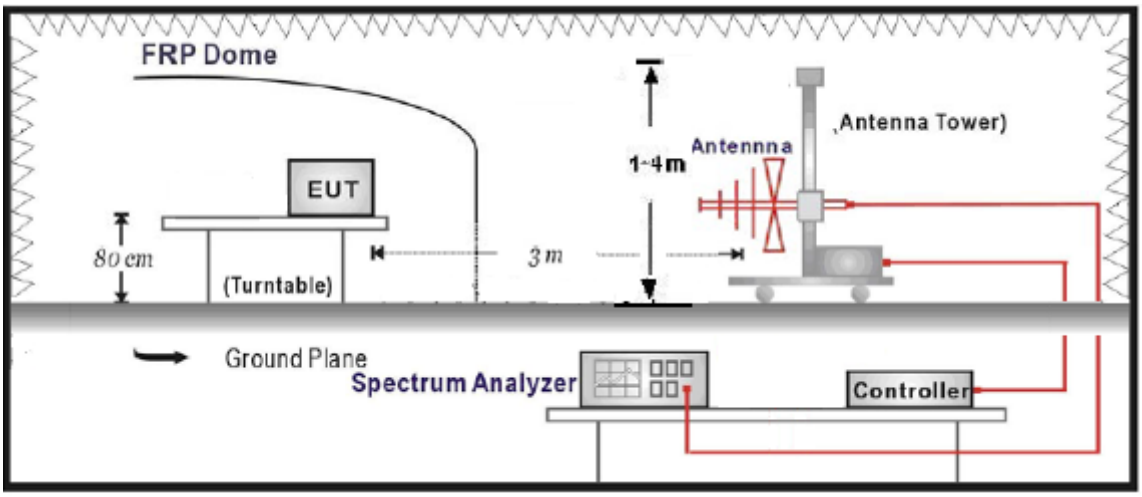
3.5 TEST SETUP CONFIGURATION

The information contained within this report is intended to show verification of compliance of the EUT to the requirements of CFR 47 FCC Part 90.
Unilab has verified the construction and function in typical operation. All the test modes were carried out with the EUT in normal operation, which was shown in this test report.

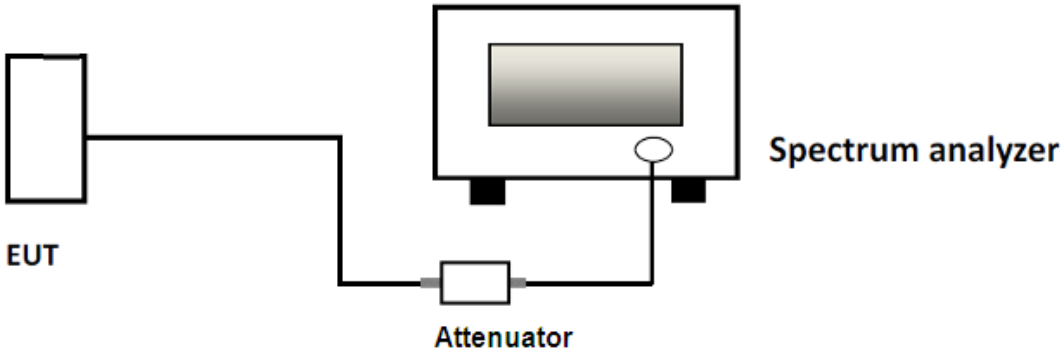
4. TRANSMITTER OUTPUT POWER

4.1 TEST SETUP LAYOUT

Transmitter Radiated Power



Transmitter Conducted Output Power



4.2 TEST PROCEDURE

Transmitter Radiated Out Power

1. The EUT was placed on the top of the turntable in semi-anechoic chamber.
2. The test shall be made in the transmitting mode. Antenna tower was scan (from 1 m to 4 m) and the turntable was rotated by 360degrees to determine the position of the highest radiation.
3. The receiving Horn antenna was placed 0.5 meters far away from the turntable.
4. The receiving antenna was fixed on the same height with the EUT to find maximum suspected emissions. Recorded suspected value is indicated as Read Level (Raw).
5. Replace the EUT by standard antenna and feed the RF port by signal generator.
6. Adjust the frequency of the signal generator to the suspected emission and slightly rotate the turntable to locate the position with maximum reading.
7. Adjust the power level of the signal generator to reach the same reading with Read

Level (Raw).

8. The level of the spurious emission is the power level of (7) plus the gain of the standard antenna in dBd and minus the loss of the cable used between the signal generator and the standard antenna.

Transmitter Conducted Output Power

1. The transmitter output is connected to the spectrum analyzer through an attenuator.
2. Set RBW of spectrum analyzer to 1MHz and VBW to 3MHz.
3. Record the Conducted Output Power.

4.3 TEST RESULTS

Radio Power

12.5 KHz Channel Separation, 4FSK

Frequency (MHz)	Ant. Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
403	H	35.36	3.83	-2.99	28.54	43	14.46
403	V	36.74	3.83	-2.99	29.92	43	13.08
450	H	35.24	3.96	-3.04	28.24	43	14.76
450	V	36.84	3.96	-3.04	29.84	43	13.16
473	H	35.21	3.97	-3.10	28.14	43	14.86
473	V	36.47	3.97	-3.10	29.40	43	13.6

12.5 KHz Channel Separation, GMSK

Frequency (MHz)	Ant. Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
403	H	35.1	3.83	-2.99	28.28	43	14.72
403	V	36.6	3.83	-2.99	29.78	43	13.22
450	H	35.13	3.96	-3.04	28.13	43	14.87
450	V	36.44	3.96	-3.04	29.44	43	13.56
473	H	35.05	3.97	-3.10	27.98	43	15.02
473	V	36.3	3.97	-3.10	29.23	43	13.77

25KHz Channel Separation, 4FSK

Frequency (MHz)	Ant. Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
403	H	36.23	3.83	-2.99	29.41	43	13.59
403	V	36.92	3.83	-2.99	30.10	43	12.9
450	H	36.33	3.96	-3.04	29.33	43	13.67
450	V	37.14	3.96	-3.04	30.14	43	12.86
473	H	35.9	3.97	-3.10	28.83	43	14.17
473	V	37.1	3.97	-3.10	30.03	43	12.97

25 KHz Channel Separation, GMSK

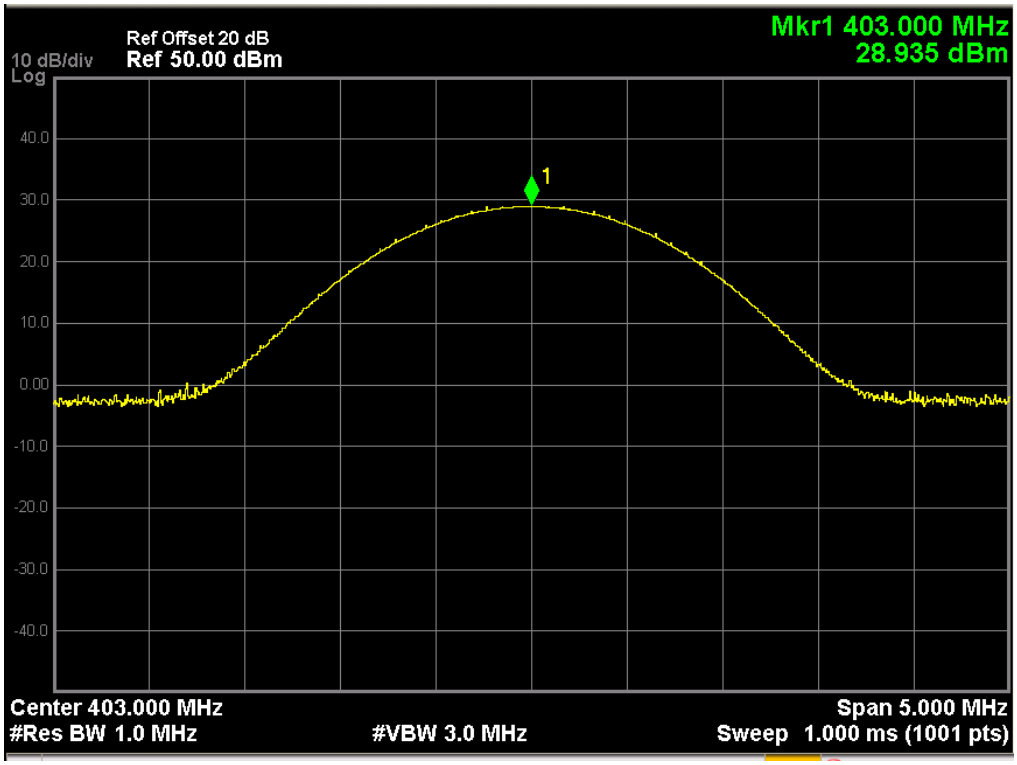
Frequency (MHz)	Ant. Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
403	H	36.21	3.83	-2.99	29.39	43	13.61
403	V	36.94	3.83	-2.99	30.12	43	12.88
450	H	36.35	3.96	-3.04	29.35	43	13.65
450	V	37.09	3.96	-3.04	30.09	43	12.91
473	H	35.84	3.97	-3.10	28.77	43	14.23
473	V	37.11	3.97	-3.10	30.04	43	12.96

Conductor Power

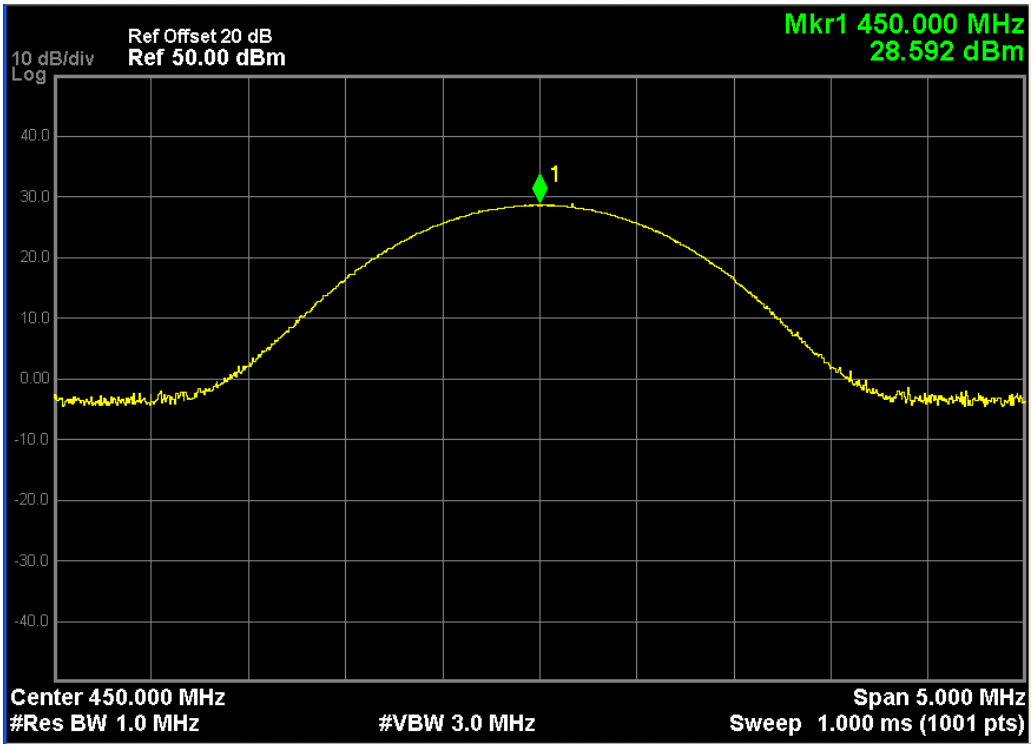
12.5 KHz Channel Separation, 4FSK			25 KHz Channel Separation, 4FSK		
Frequency (MHz)	Power Value		Frequency (MHz)	Power Value	
403	28.94dBm	0.783W	403	29.78dBm	0.951W
450	28.59dBm	0.723W	450	29.41dBm	0.873W
473	28.02dBm	0.634W	473	28.97dBm	0.789W
12.5 KHz Channel Separation, GMSK			**25 KHz Channel Separation, GMSK**		
Frequency (MHz)	Power Value		Frequency (MHz)	Power Value	
403	28.84dBm	0.766W	403	29.79dBm	0.993W
450	28.54dBm	0.714W	450	29.31dBm	0.853W
473	28.05dBm	0.638W	473	28.87dBm	0.771W

12.5 KHz Channel Separation, 4FSK

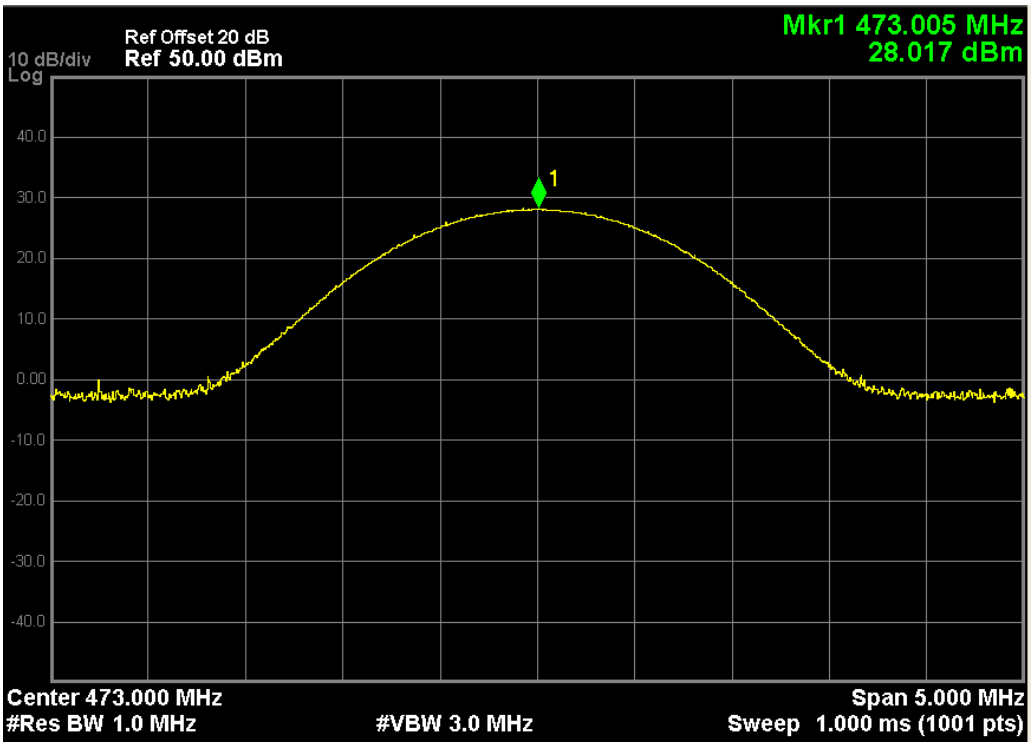
403MHz



450MHz

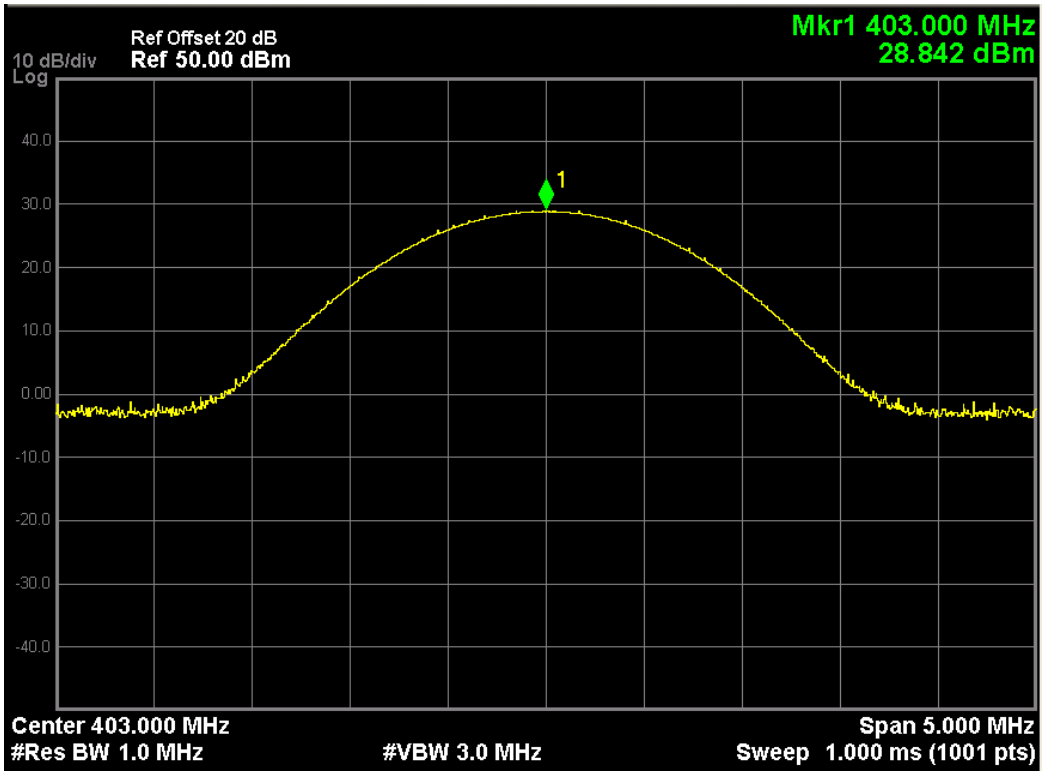


473MHz

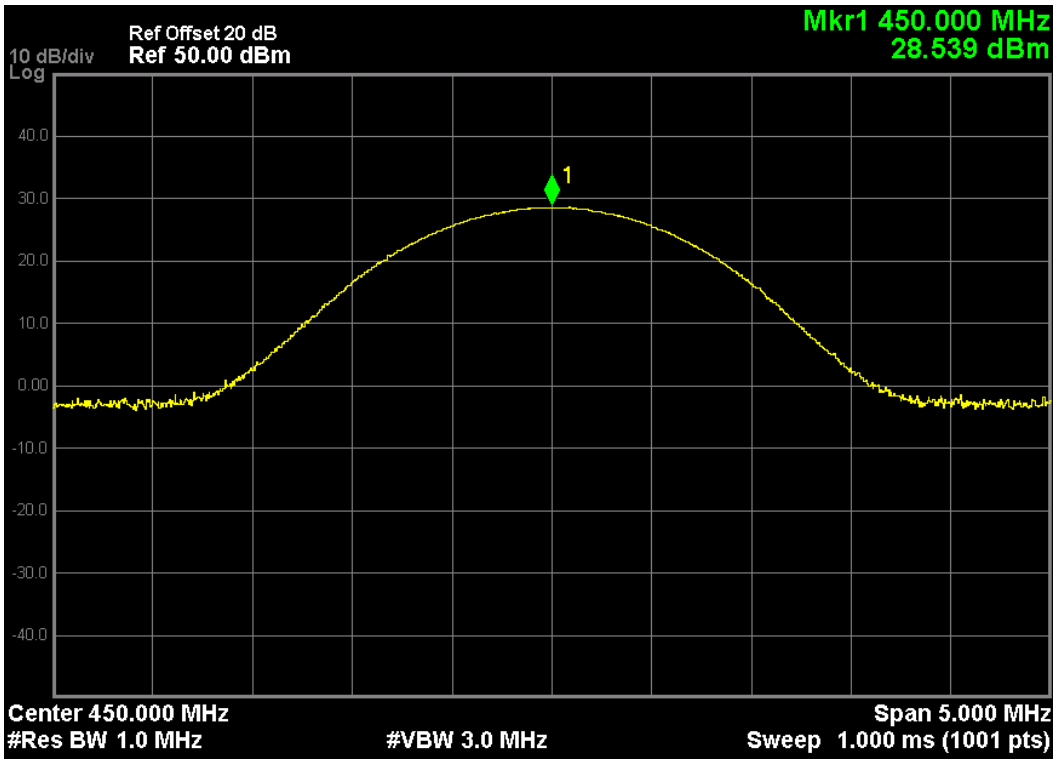


12.5 KHz Channel Separation, GMSK

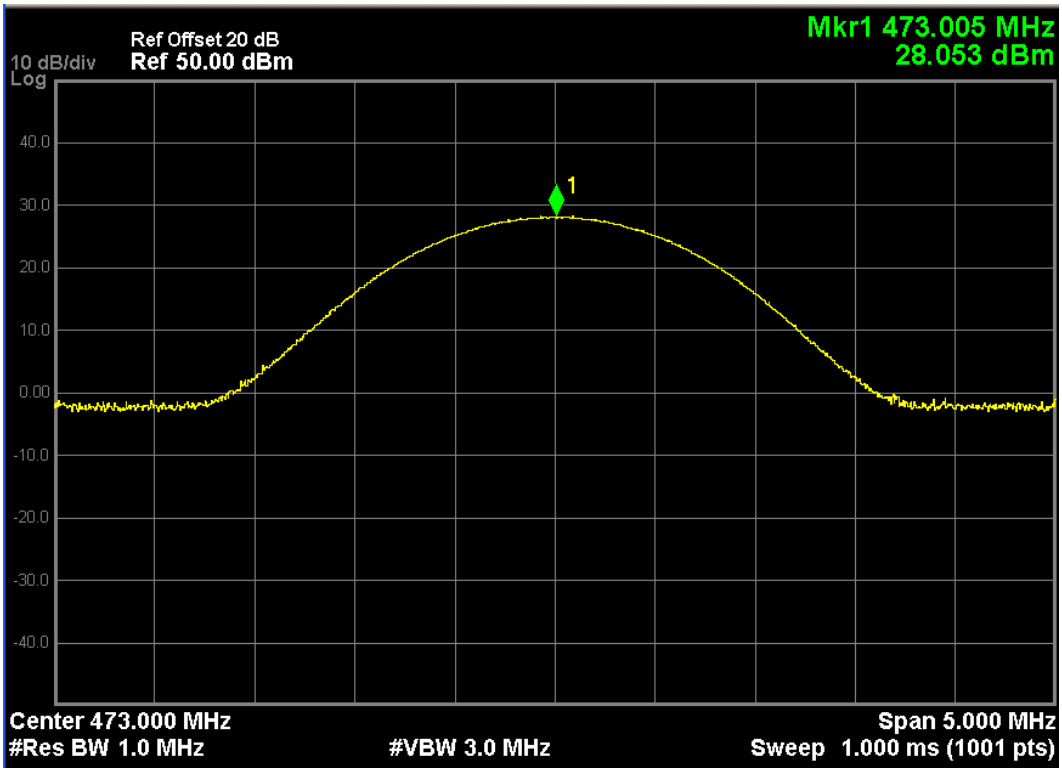
403MHz



450MHz

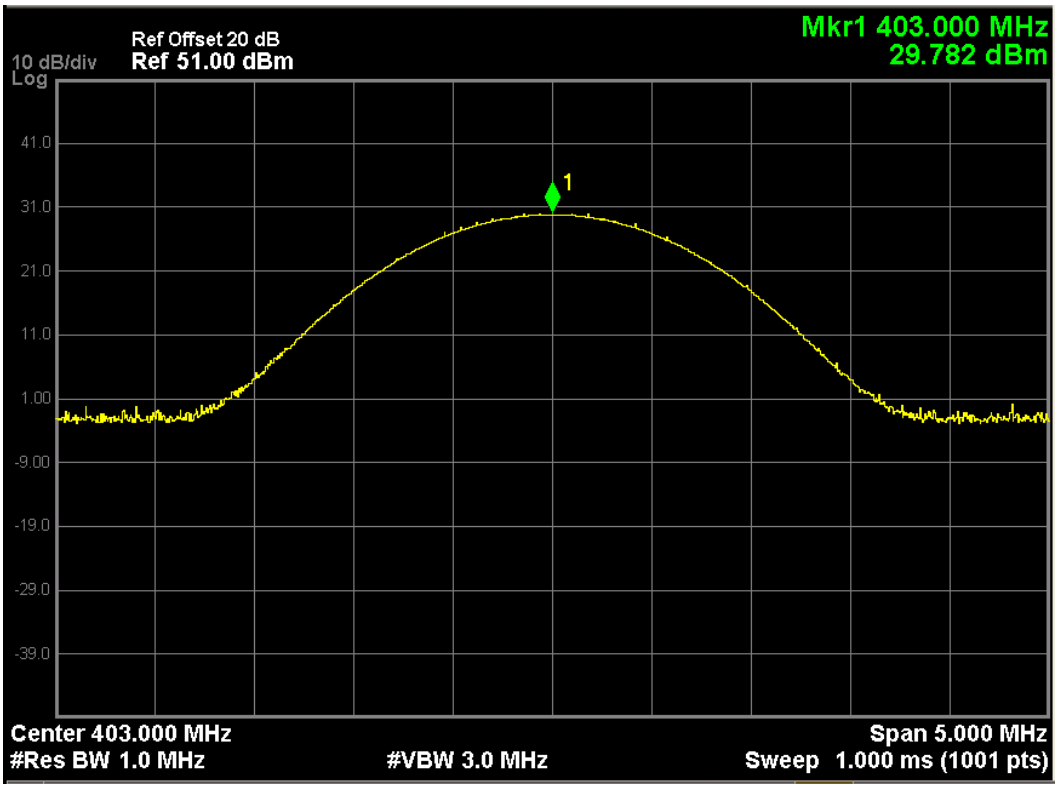


473MHz

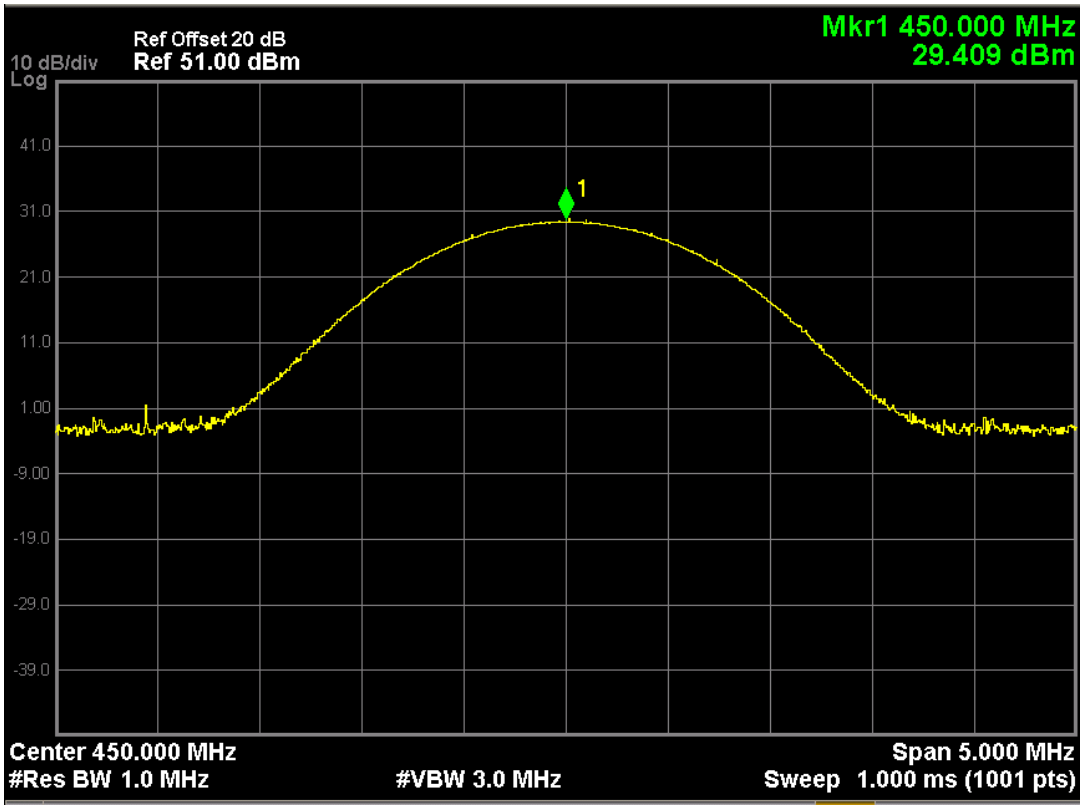


25 KHz Channel Separation, 4FSK

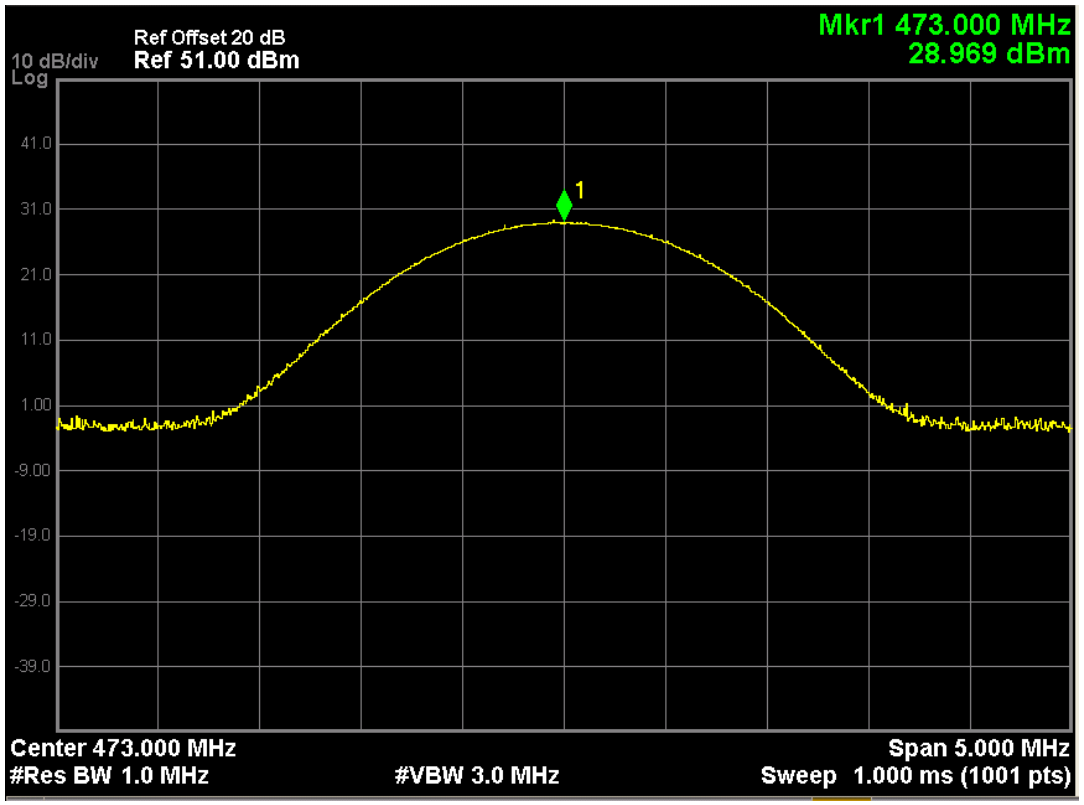
403MHz



450MHz

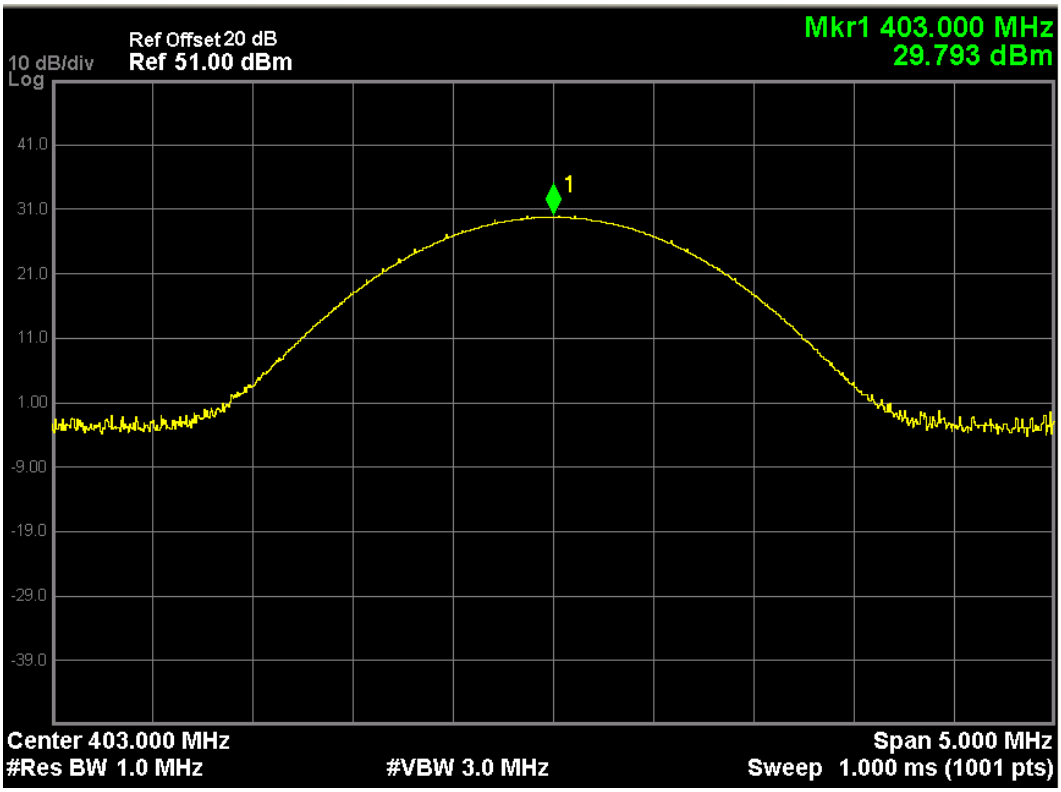


473MHz

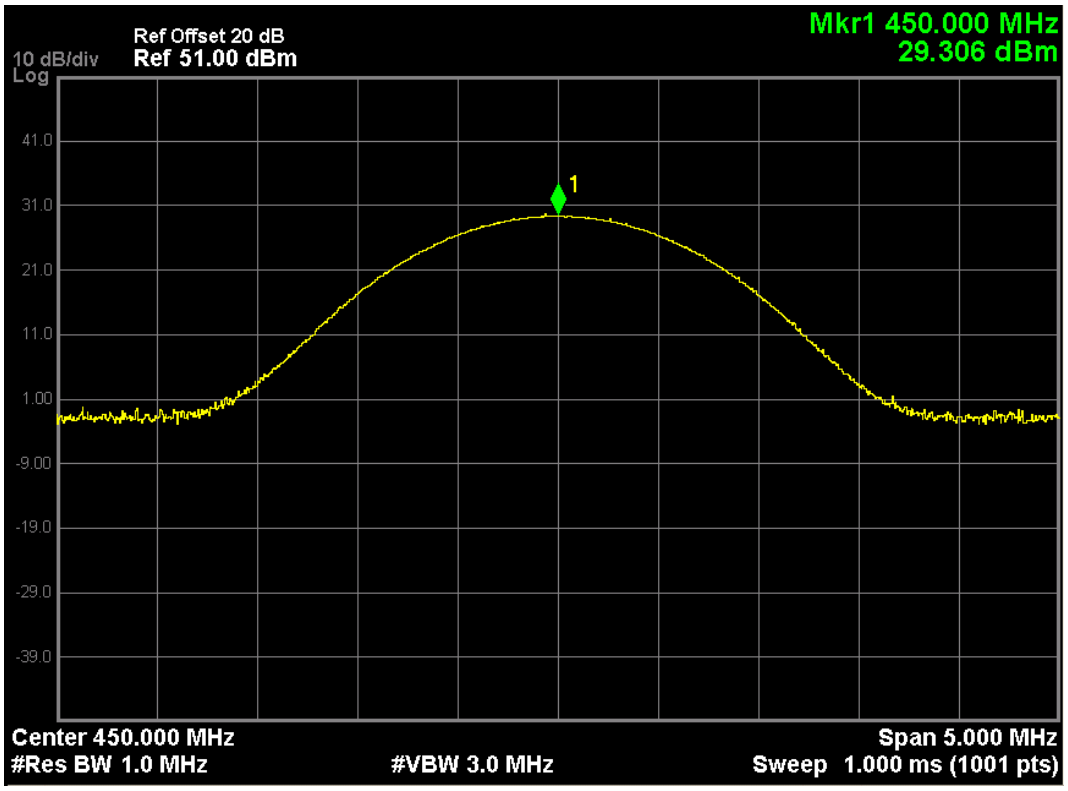


25 KHz Channel Separation, GMSK

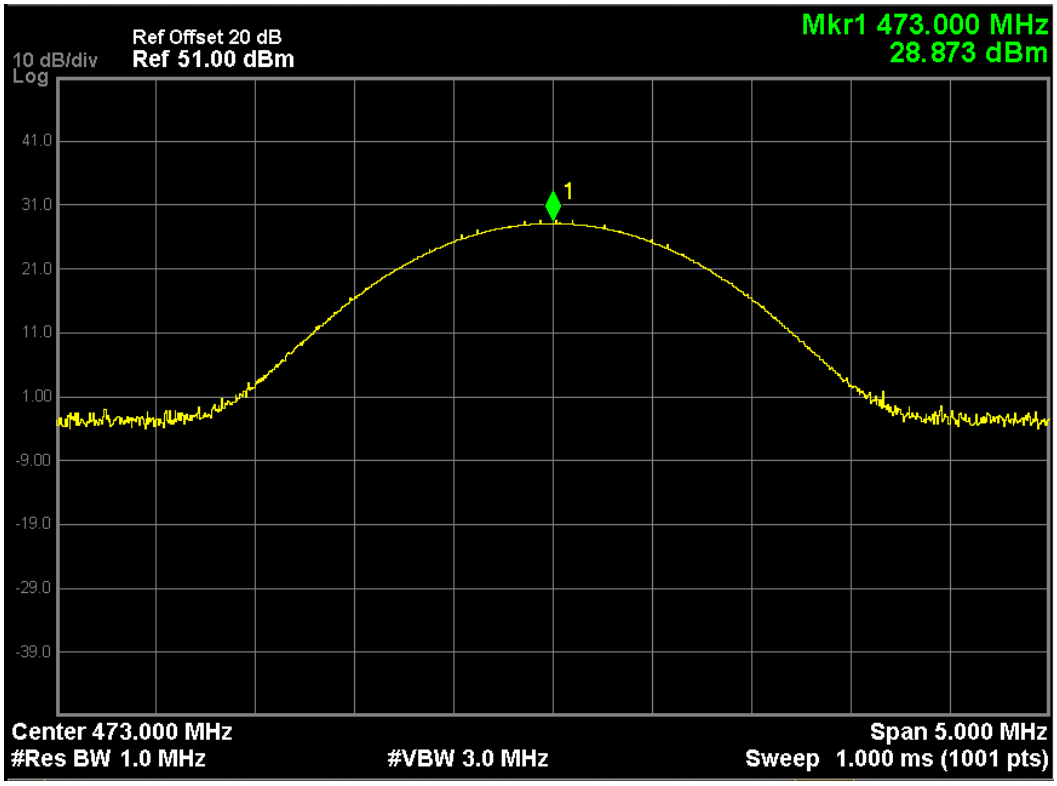
403MHz



450MHz

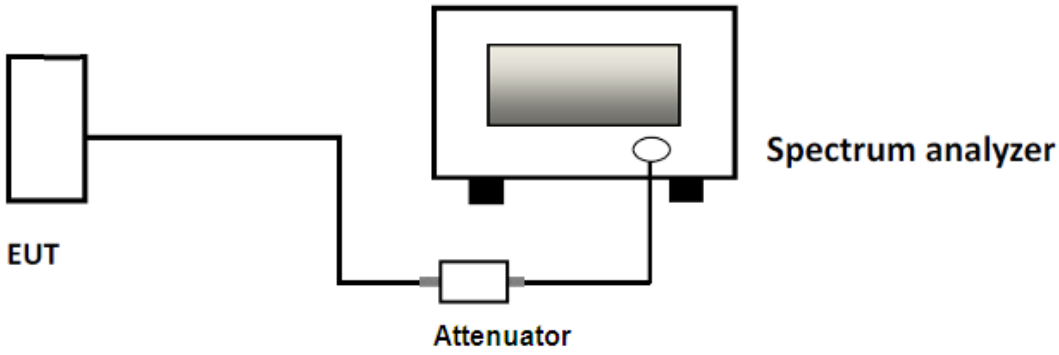


473MHz


Ref Offset 20 dB
10 dB/div
Log
Ref 51.00 dBm
Mkr1 473.000 MHz
28.873 dBm
41.0
31.0
21.0
11.0
1.00
-9.00
-19.0
-29.0
-39.0
1
Center 473.000 MHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Span 5.000 MHz
Sweep 1.000 ms (1001 pts)

5. TRANSMITTER SPURIOUS CONDUCTED EMISSION

5.1 TEST SETUP LAYOUT



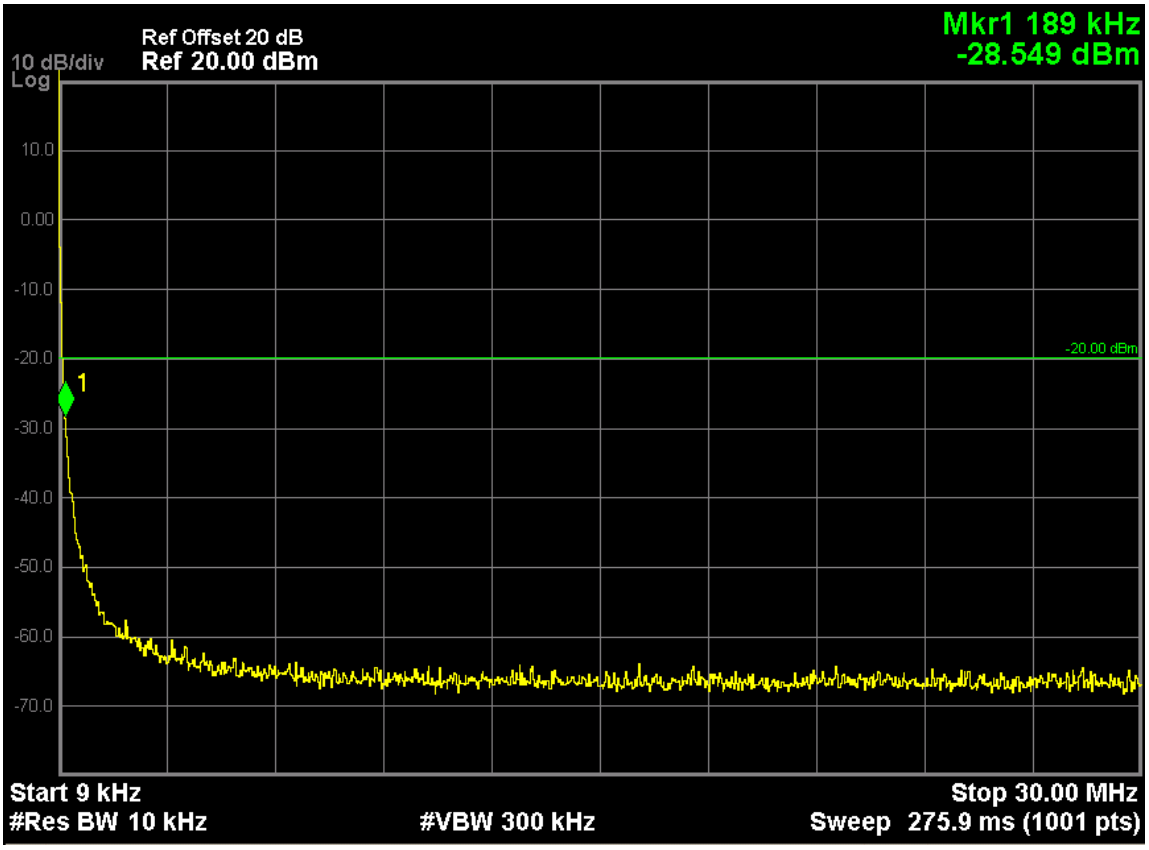
5.2 TEST PROCEDURE

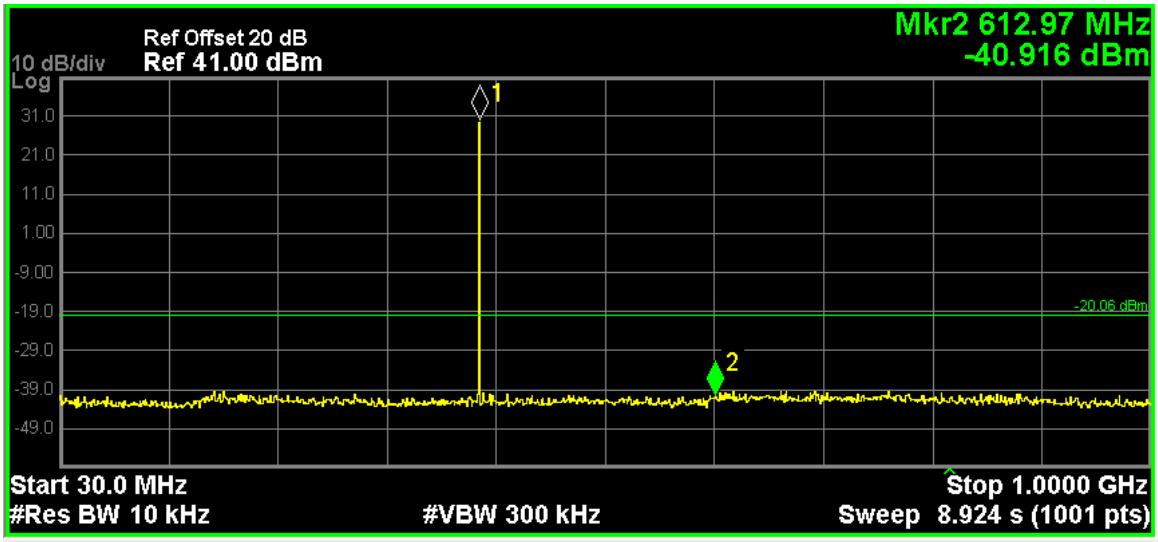
1. The transmitter output is connected to the spectrum analyzer through an attenuator.
2. Adjust the spectrum analyzer for the following settings:
   1) Resolution Bandwidth = 10 KHz for spurious emissions below 1 GHz, and 1 MHz for spurious emissions above 1 GHz.
   2) Video Bandwidth = 300KHz for spurious emissions below 1 GHz, and 3 MHz for spurious emissions above 1 GHz.
   3) Sweep Speed slow enough to maintain measurement calibration. Detector Mode = Positive Peak.
3. For 12.5 KHz channel separation, on any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in KHz) for of more than 12.5 KHz: at least 50+10 log(P) dB or 70 dB, whichever is lesser attenuation.
4. For 25 KHz channel separation, on any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth, at least 43+10 log(P) dB attenuation.

5.3 TEST RESULTS

12.5 KHz Channel Separation, 4FSK

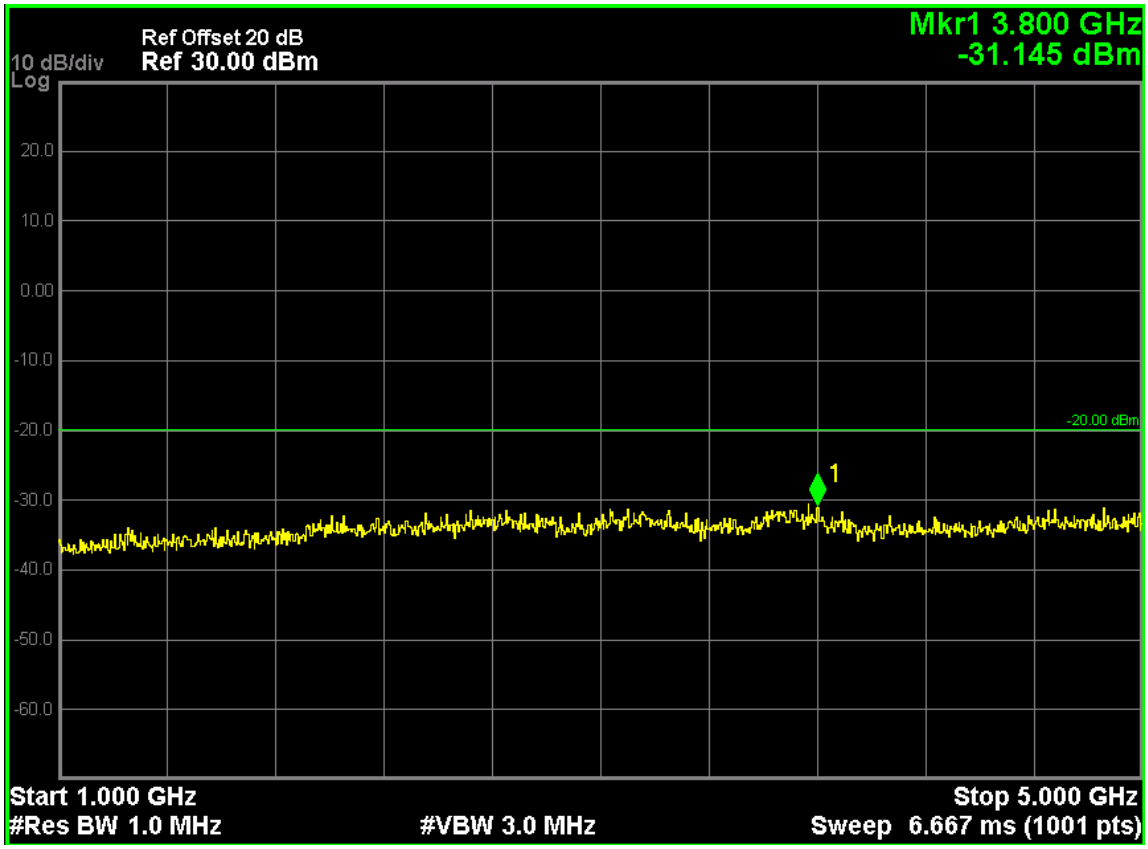
403MHz



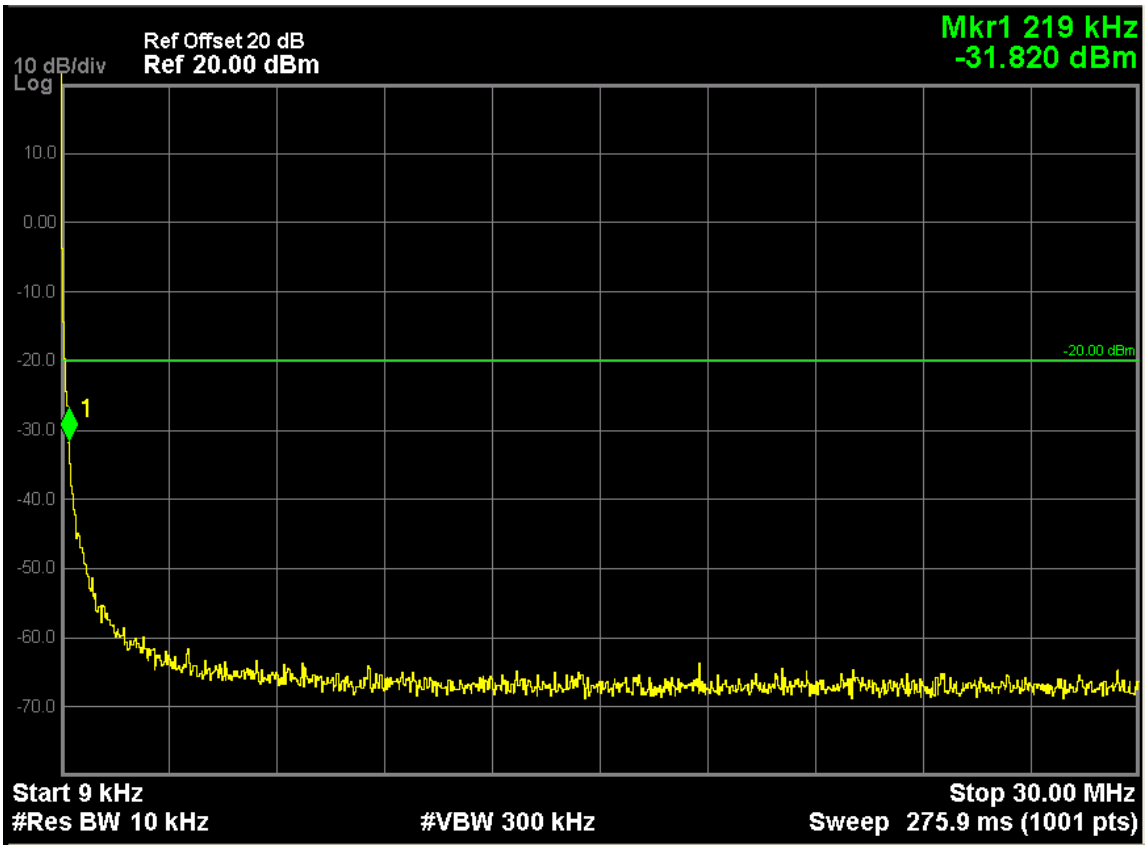


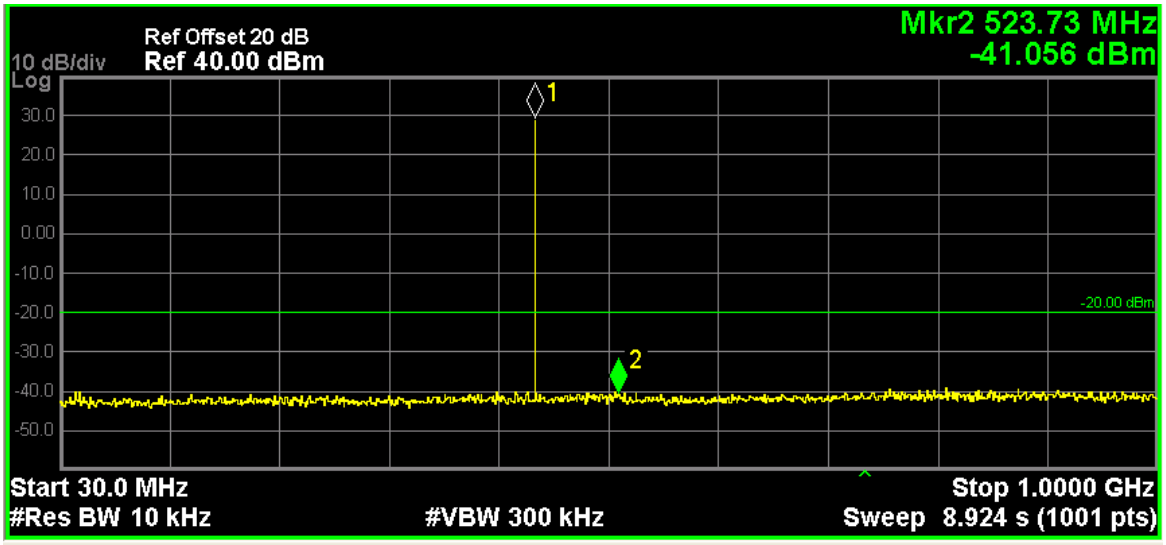
MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	403.45 MHz	29.413 dBm			
2	N	1	f	612.97 MHz	-40.916 dBm			
3								

Note: Mark1 is carrier


Ref Offset 20 dB
10 dB/div
Log
Ref 30.00 dBm
Mkr1 3.800 GHz
-31.145 dBm
20.0
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-20.00 dBm
1
Start 1.000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 5.000 GHz
Sweep 6.667 ms (1001 pts)

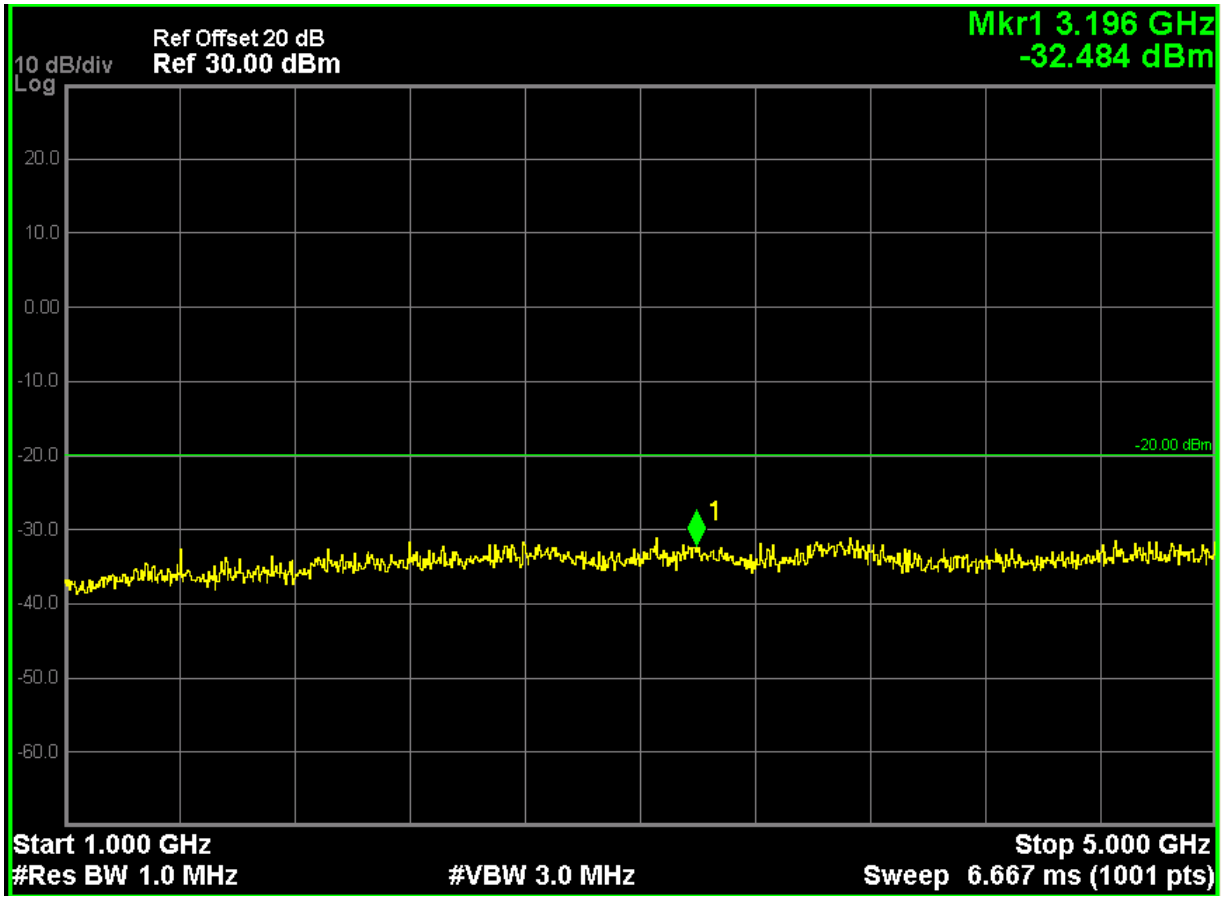
450MHz



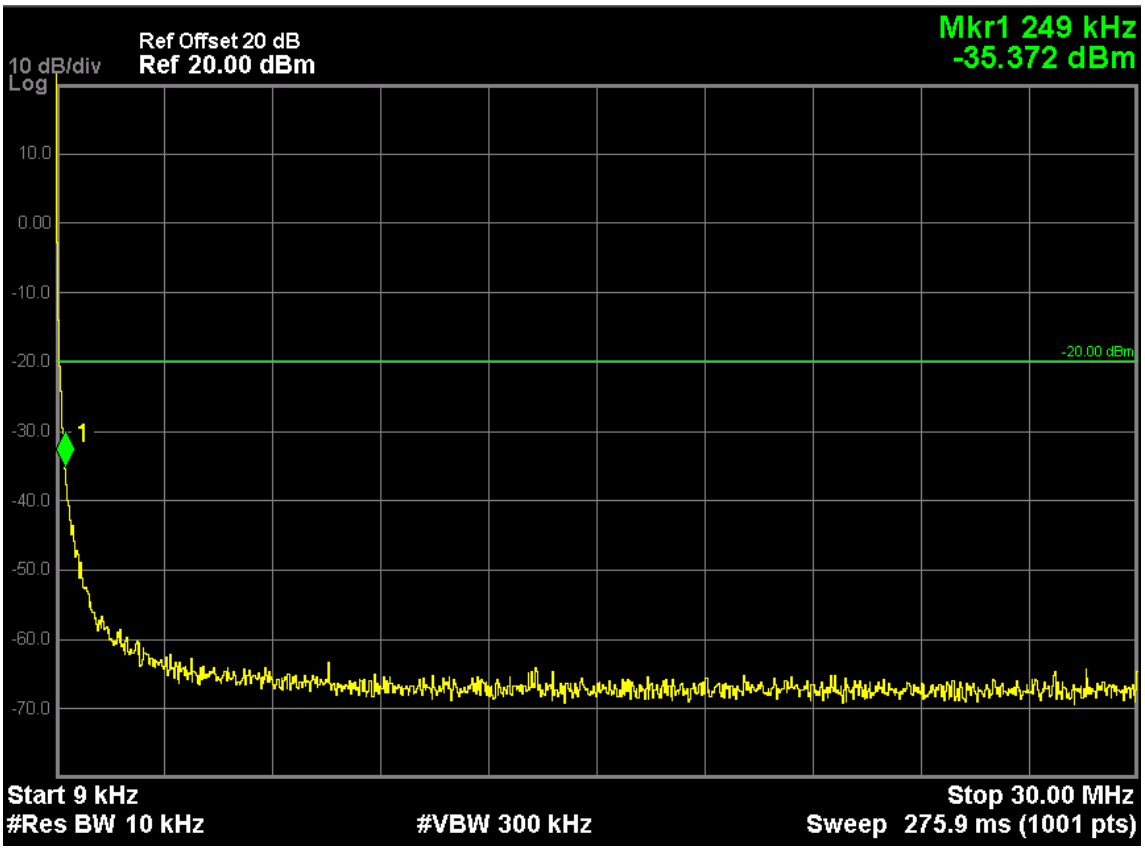


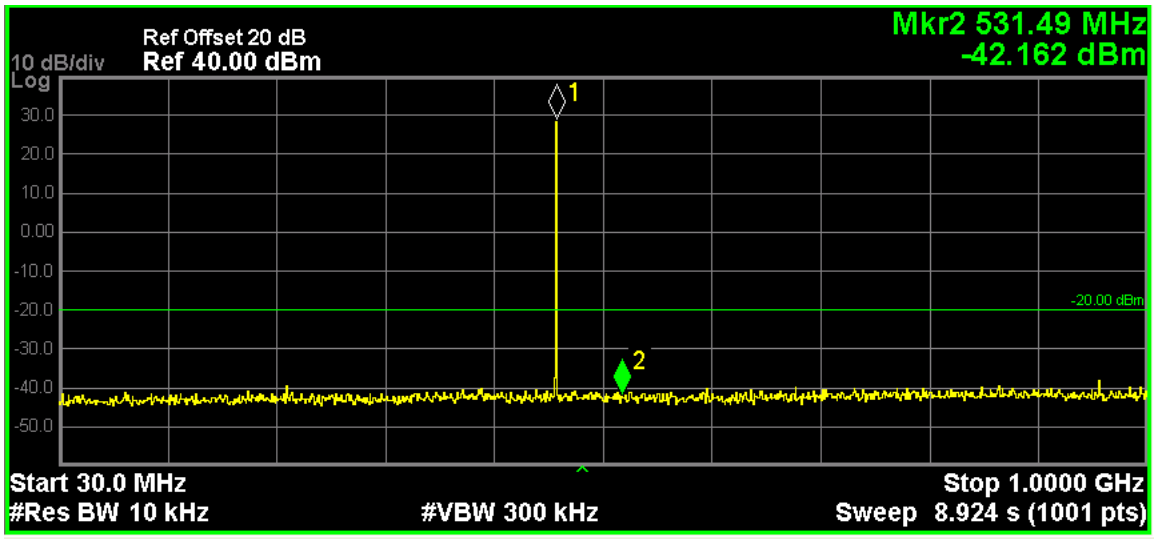
MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	450.01 MHz	28.740 dBm			
2	N	1	f	523.73 MHz	-41.056 dBm			
3								
4								
5								

Note: Mark1 is carrier


Ref Offset 20 dB
10 dB/div
Log
Ref 30.00 dBm
Mkr1 3.196 GHz
-32.484 dBm
20.0
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-20.00 dBm
1
Start 1.000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 5.000 GHz
Sweep 6.667 ms (1001 pts)

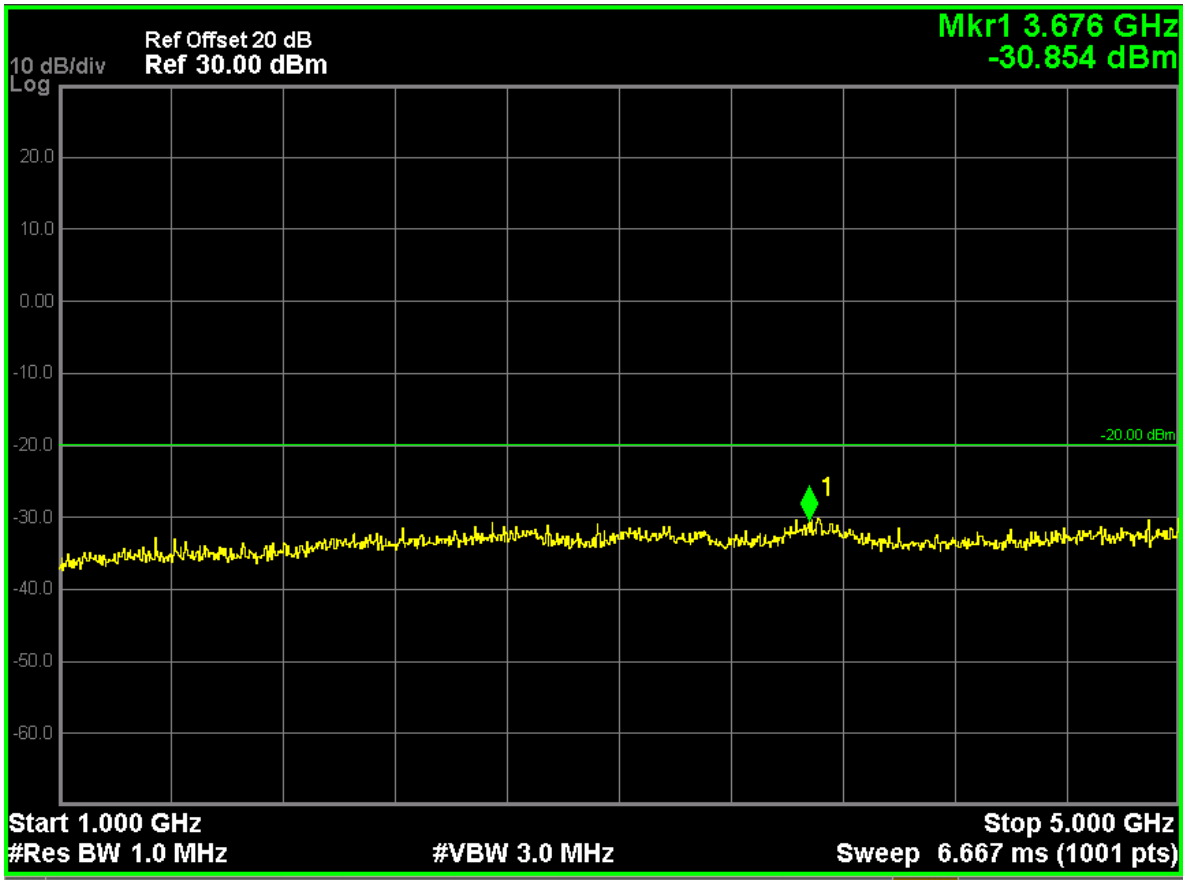
473MHz





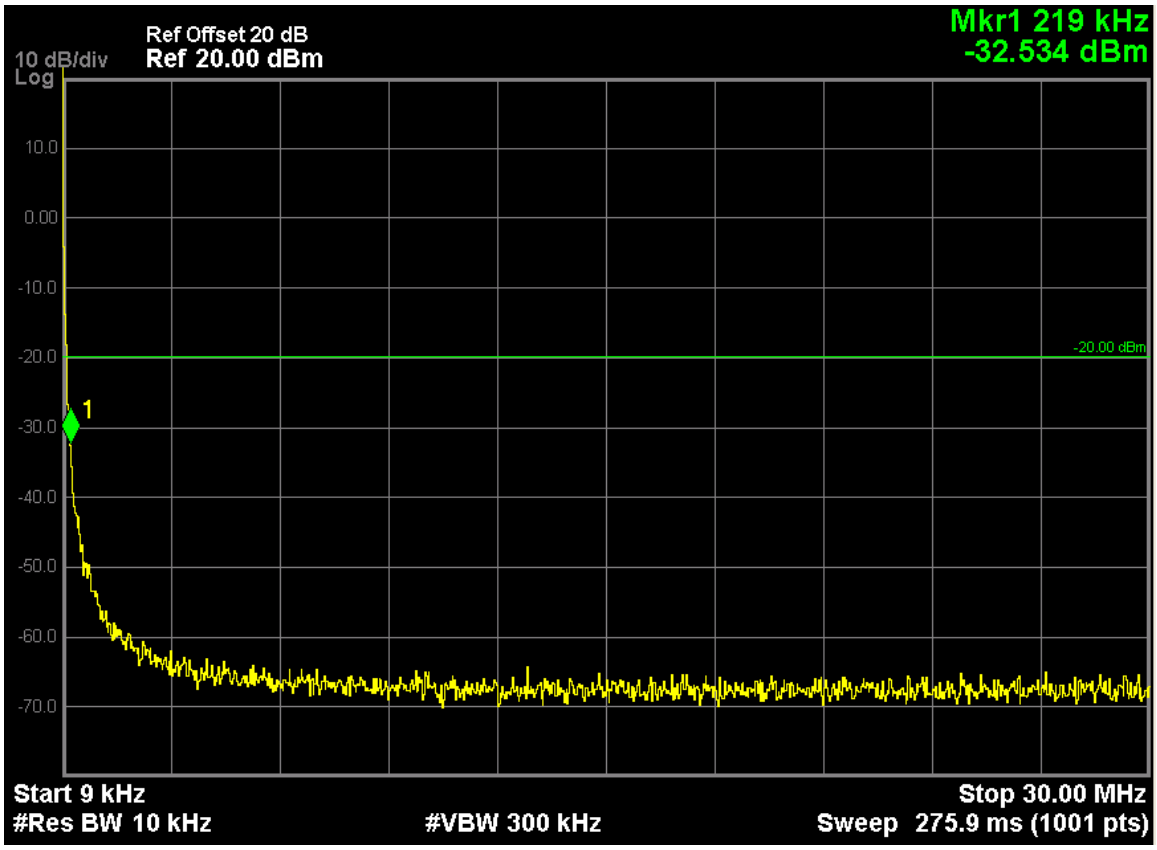
MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	473.29 MHz	28.402 dBm			
2	N	1	f	531.49 MHz	-42.162 dBm			
3								
4								
5								
6								

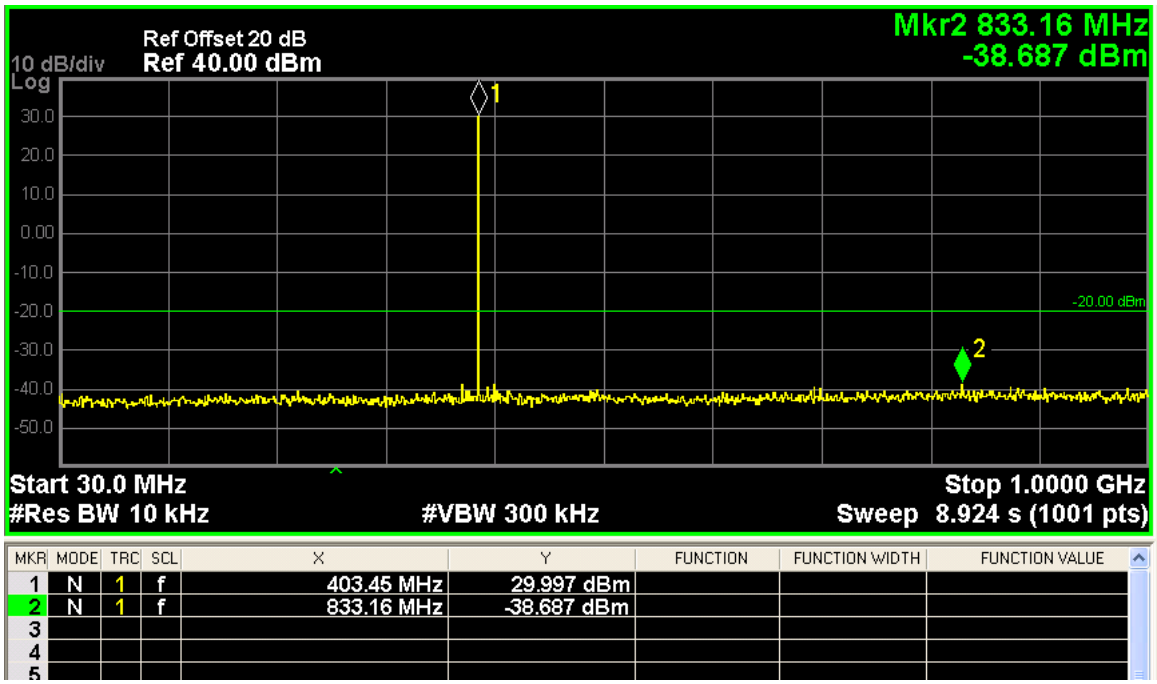
Note: Mark1 is carrier


Ref Offset 20 dB
10 dB/div
Log
Ref 30.00 dBm
Mkr1 3.676 GHz
-30.854 dBm
20.0
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-20.00 dBm
1
Start 1.000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 5.000 GHz
Sweep 6.667 ms (1001 pts)

12.5 KHz Channel Separation, GMSK

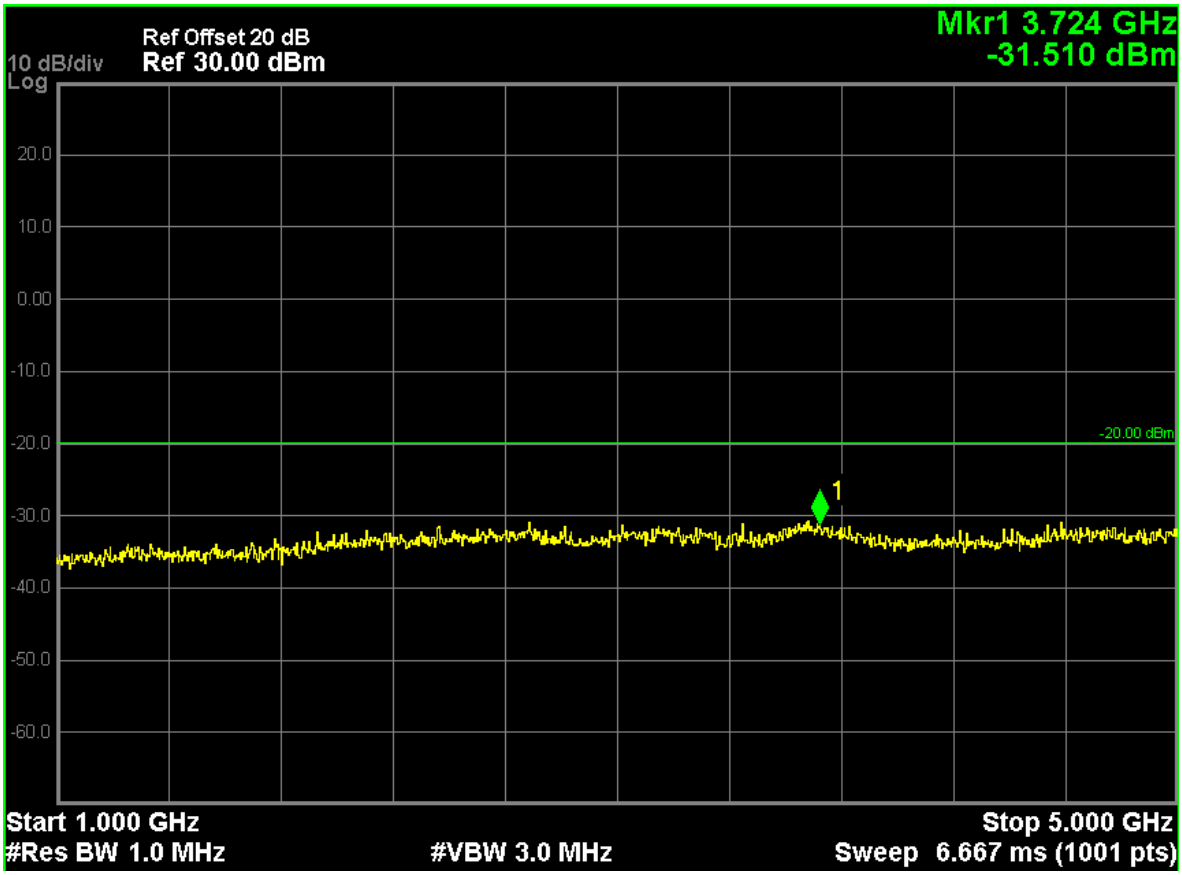
403MHz



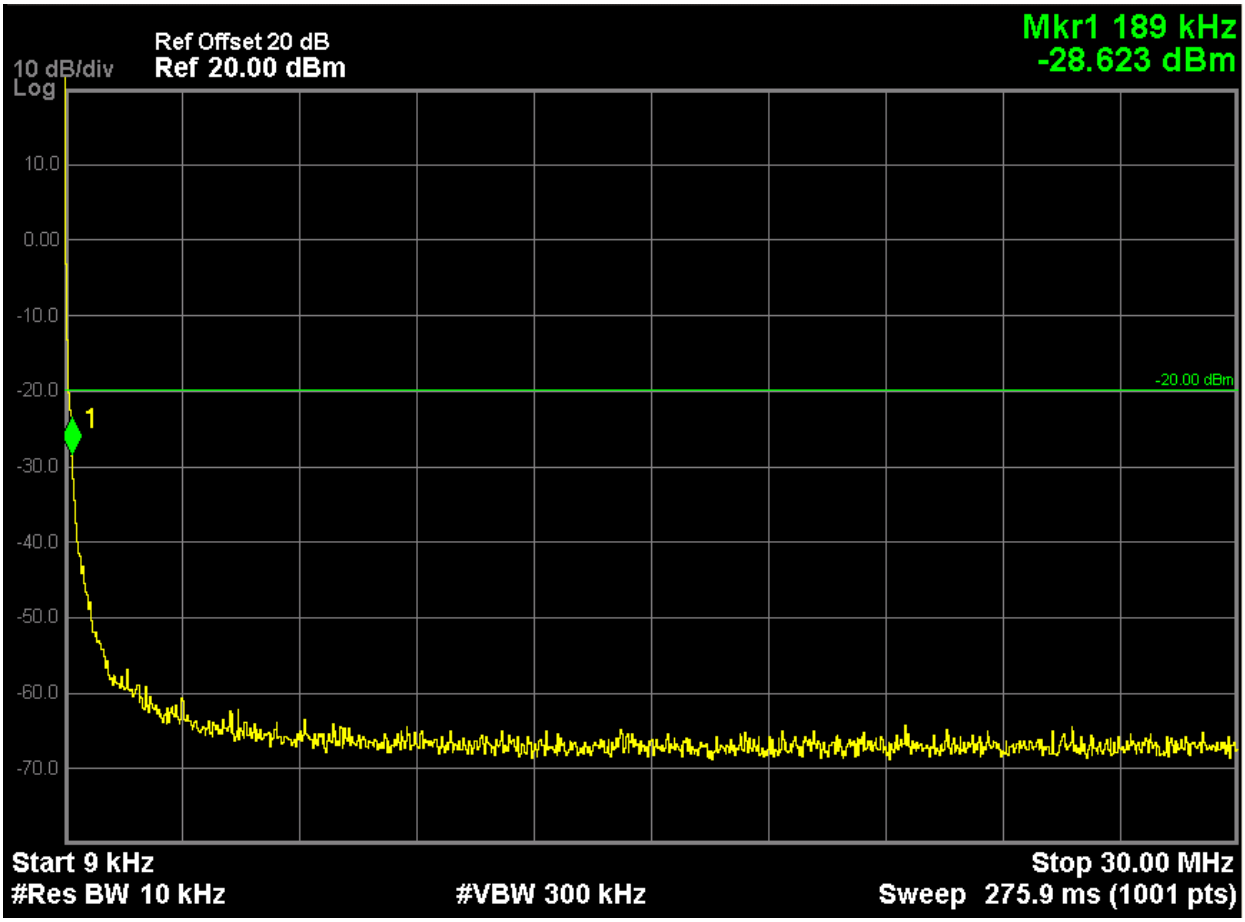


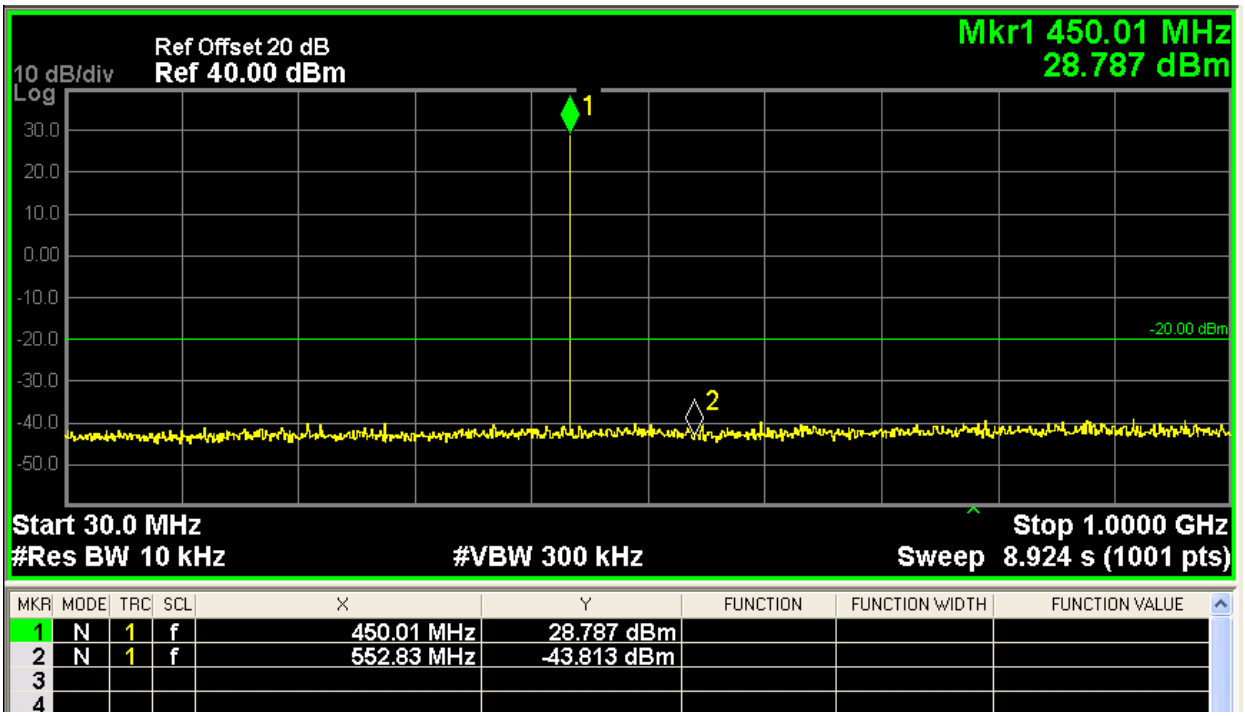
MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	403.45 MHz	29.997 dBm			
2	N	1	f	833.16 MHz	-38.687 dBm			
3								
4								
5								

Note: Mark1 is carrier


Ref Offset 20 dB
10 dB/div
Ref 30.00 dBm
Log
Mkr1 3.724 GHz
-31.510 dBm
20.0
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-20.00 dBm
1
Start 1.000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 5.000 GHz
Sweep 6.667 ms (1001 pts)

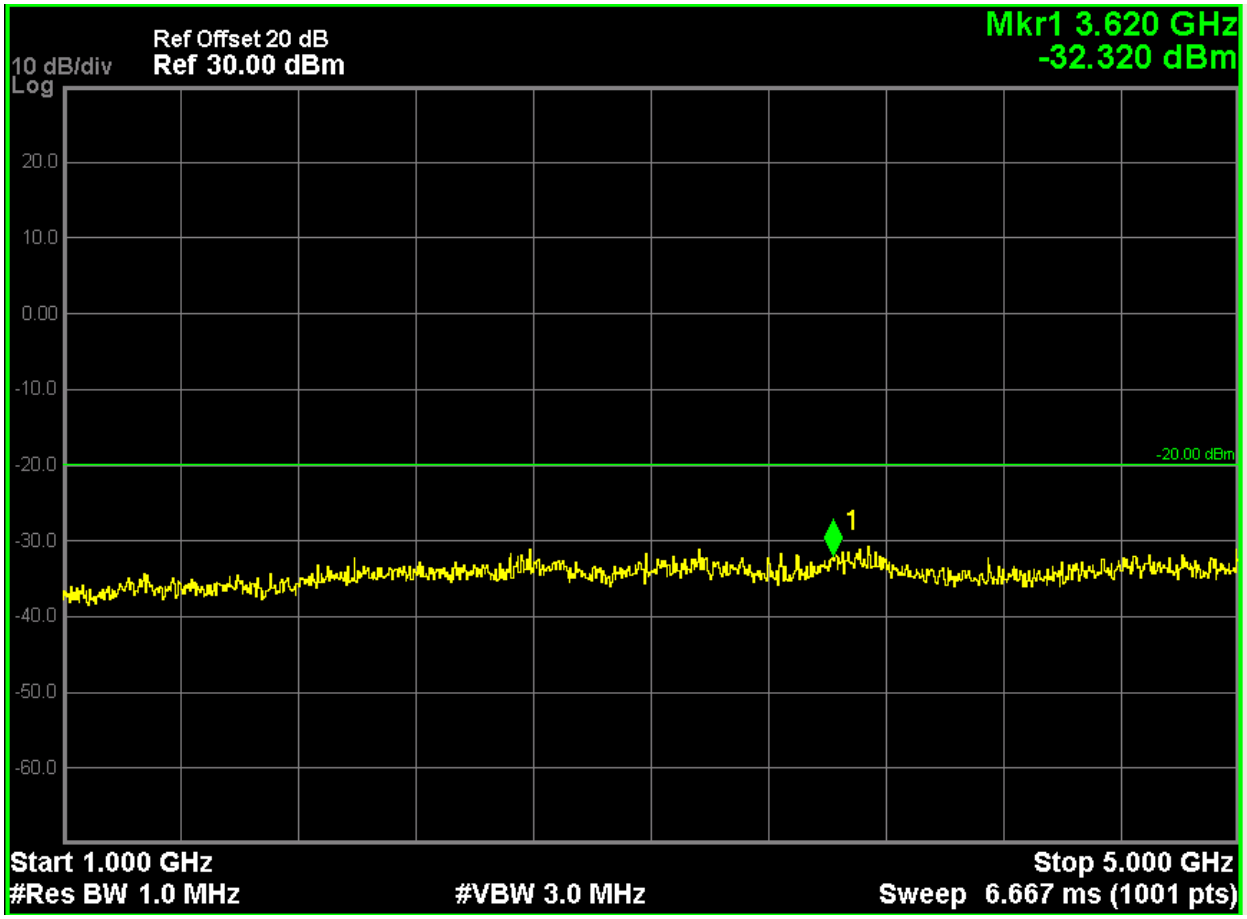
450MHz



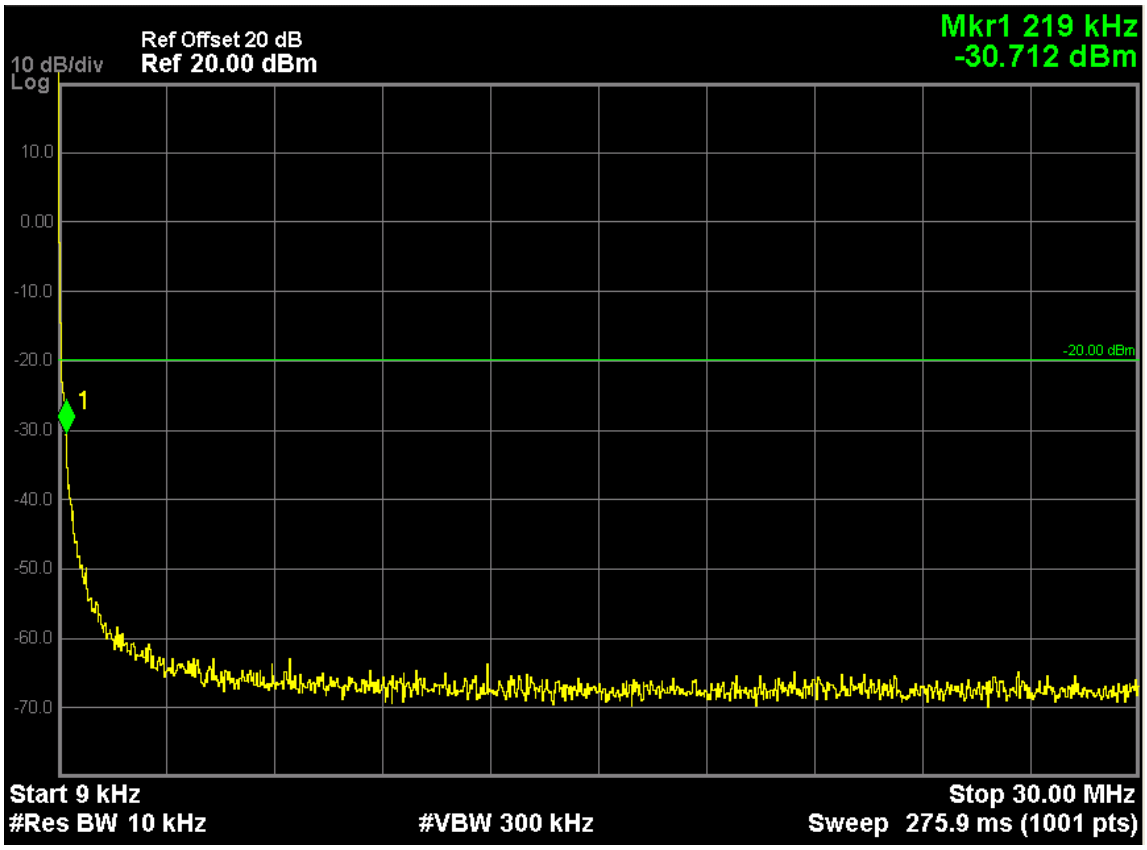


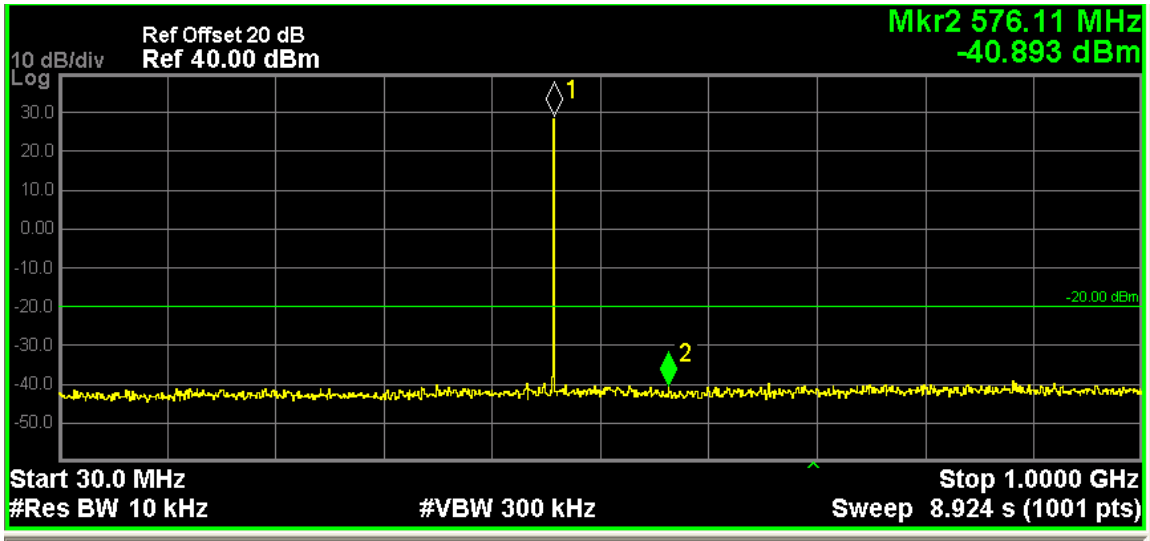
MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	450.01 MHz	28.787 dBm			
2	N	1	f	552.83 MHz	-43.813 dBm			
3								
4								

Note: Mark1 is carrier


Ref Offset 20 dB
10 dB/div
Log
Ref 30.00 dBm
Mkr1 3.620 GHz
-32.320 dBm
20.0
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-20.00 dBm
1
Start 1.000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 5.000 GHz
Sweep 6.667 ms (1001 pts)

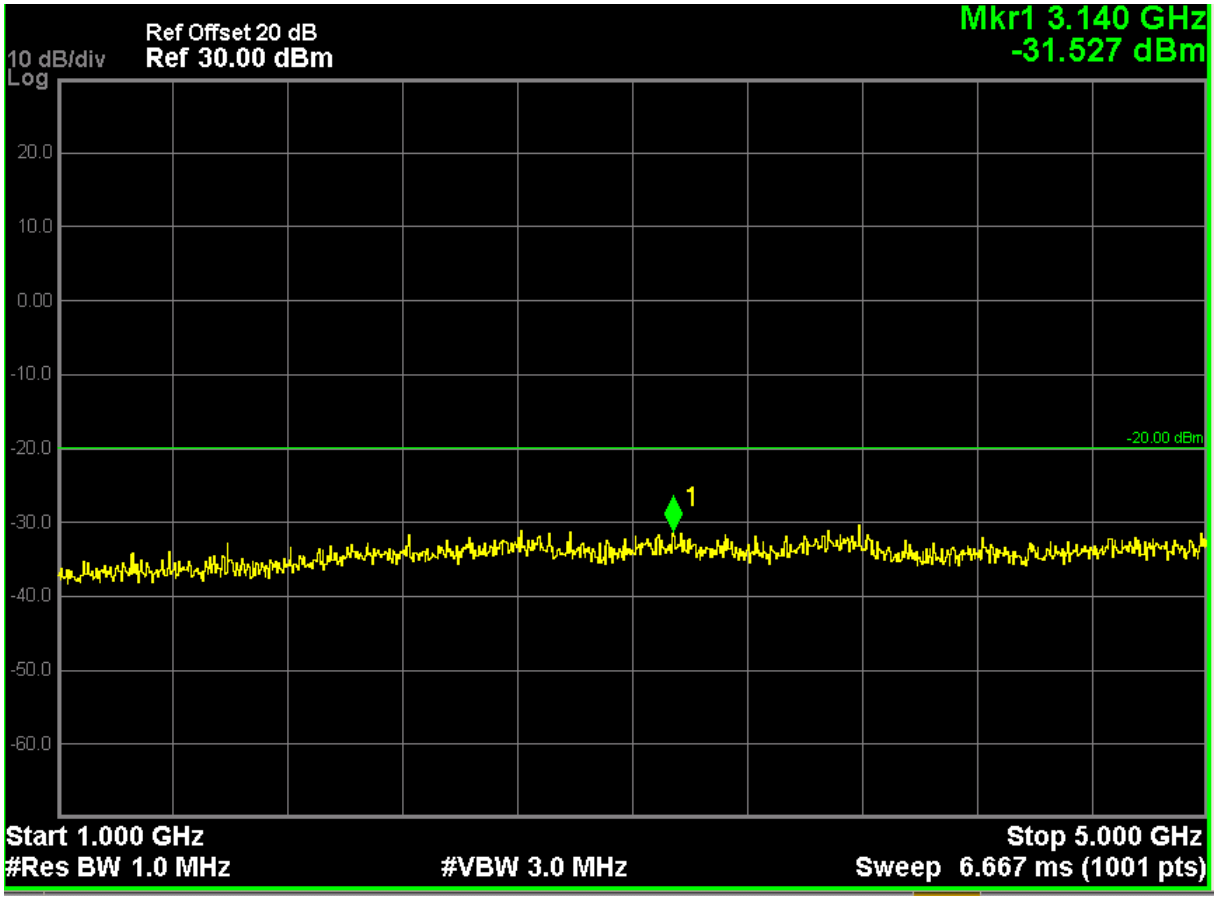
473MHz





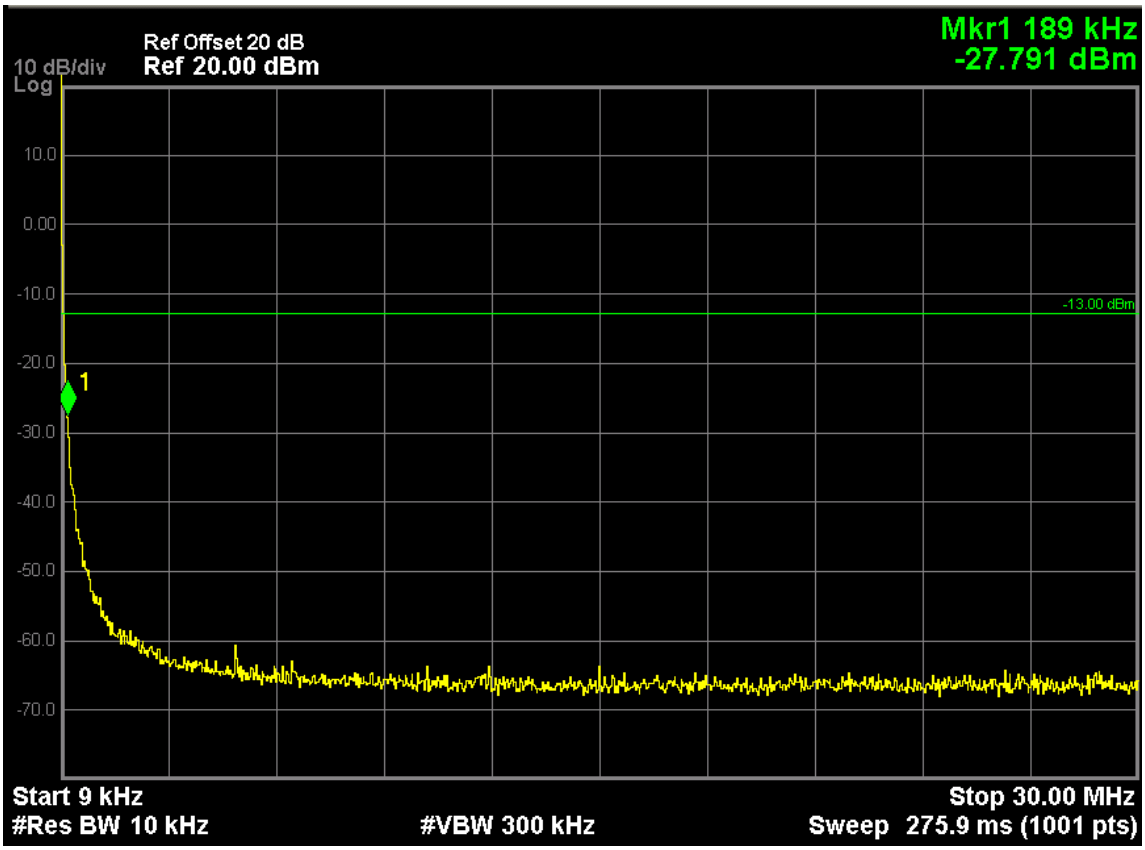
MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	473.29 MHz	28.441 dBm			
2	N	1	f	576.11 MHz	-40.893 dBm			
3								
4								

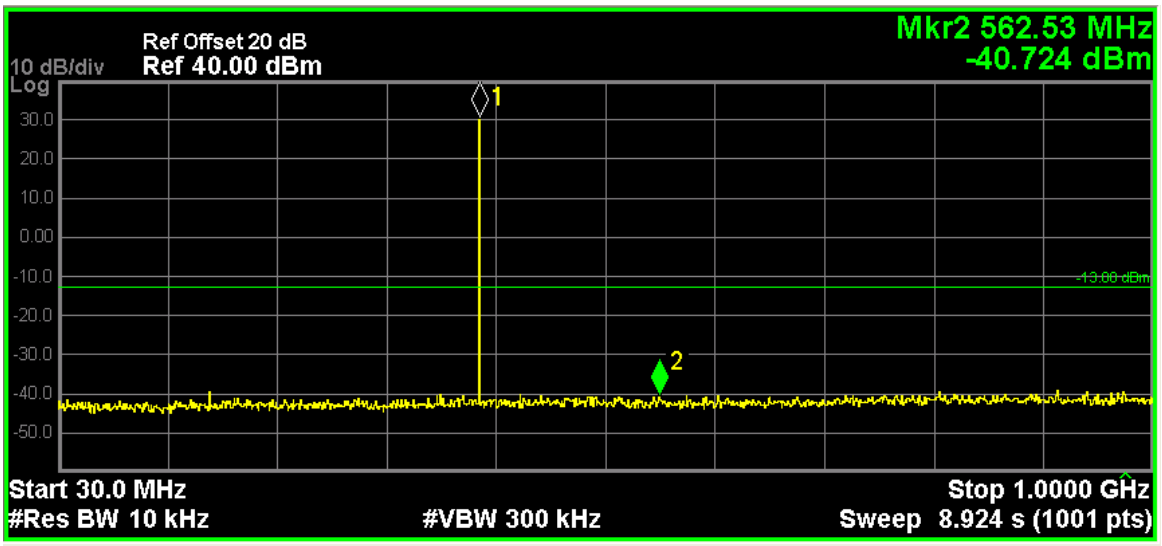
Note: Mark1 is carrier


Ref Offset 20 dB
10 dB/div
Log
Ref 30.00 dBm
Mkr1 3.140 GHz
-31.527 dBm
20.0
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-20.00 dBm
1
Start 1.000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 5.000 GHz
Sweep 6.667 ms (1001 pts)

25 KHz Channel Separation, 4FSK

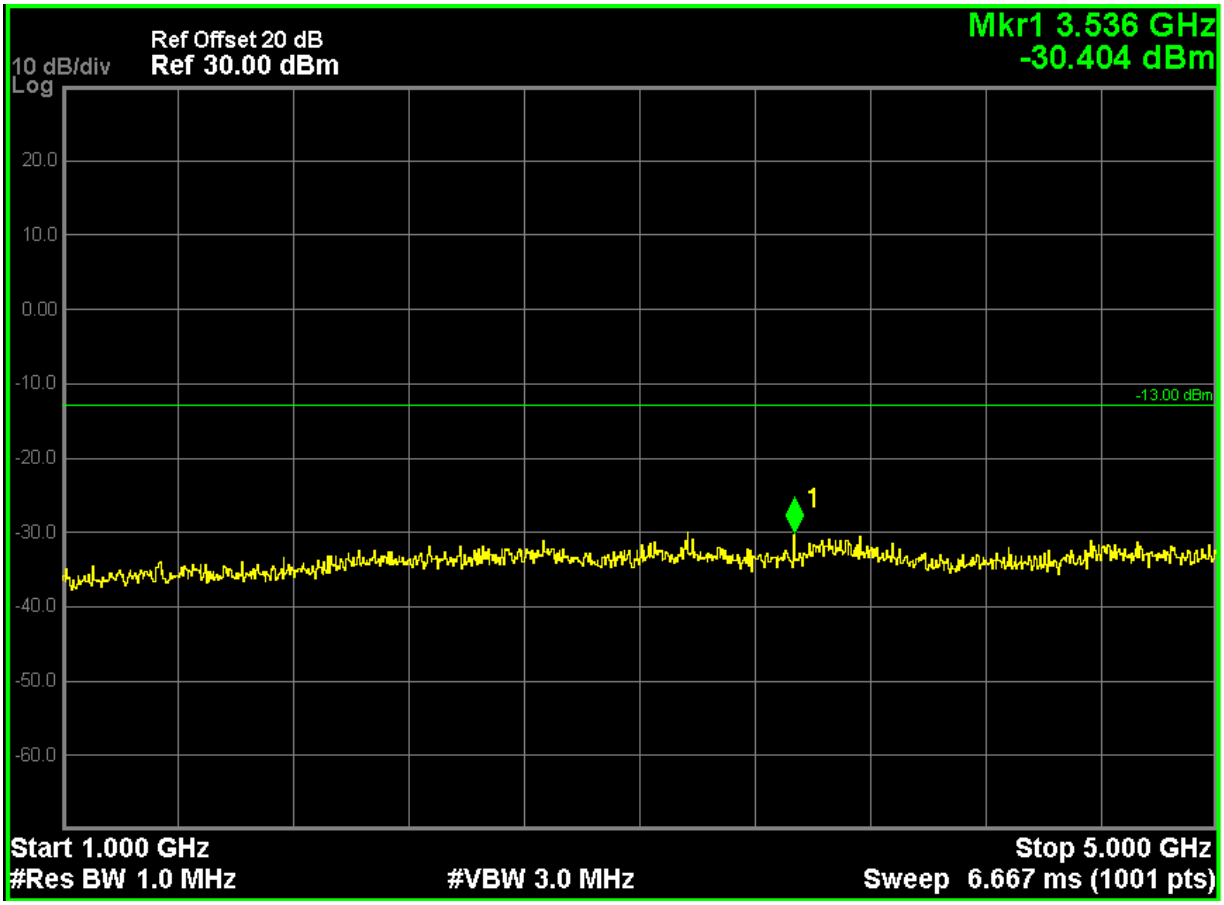
403MHz



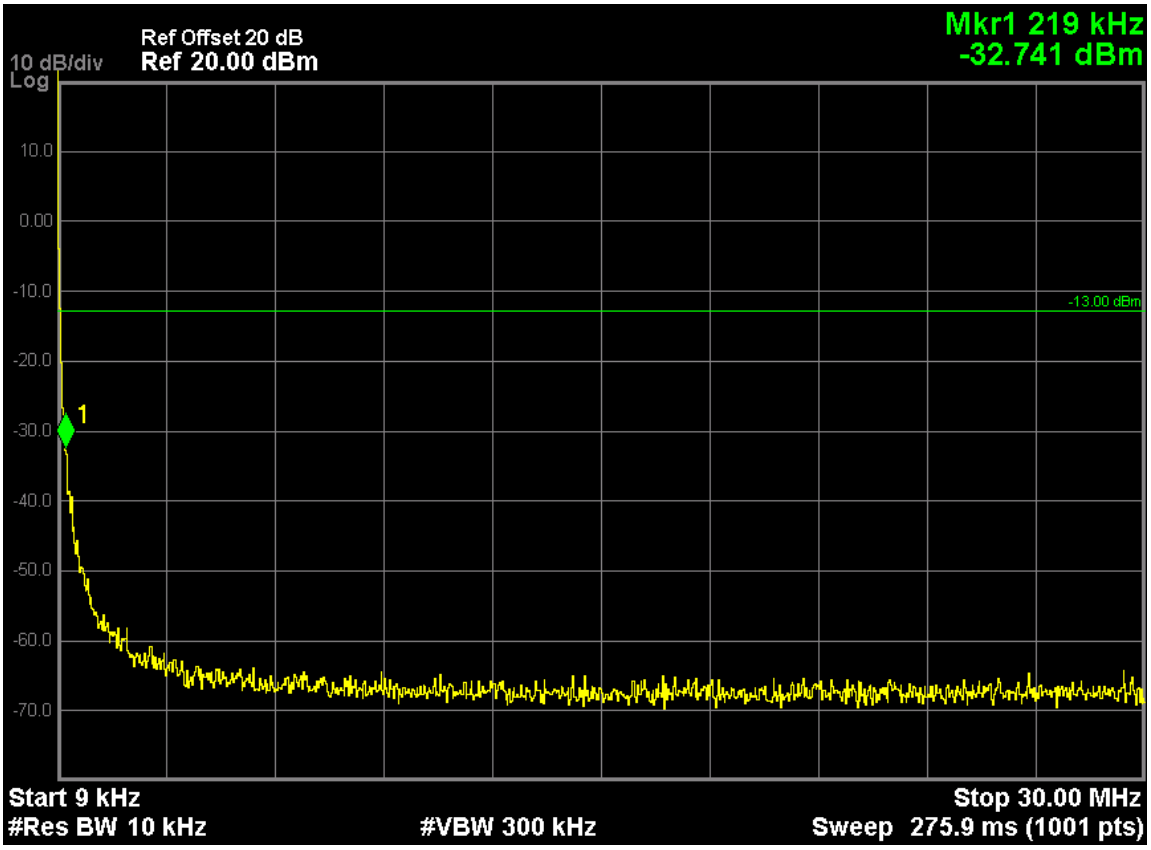


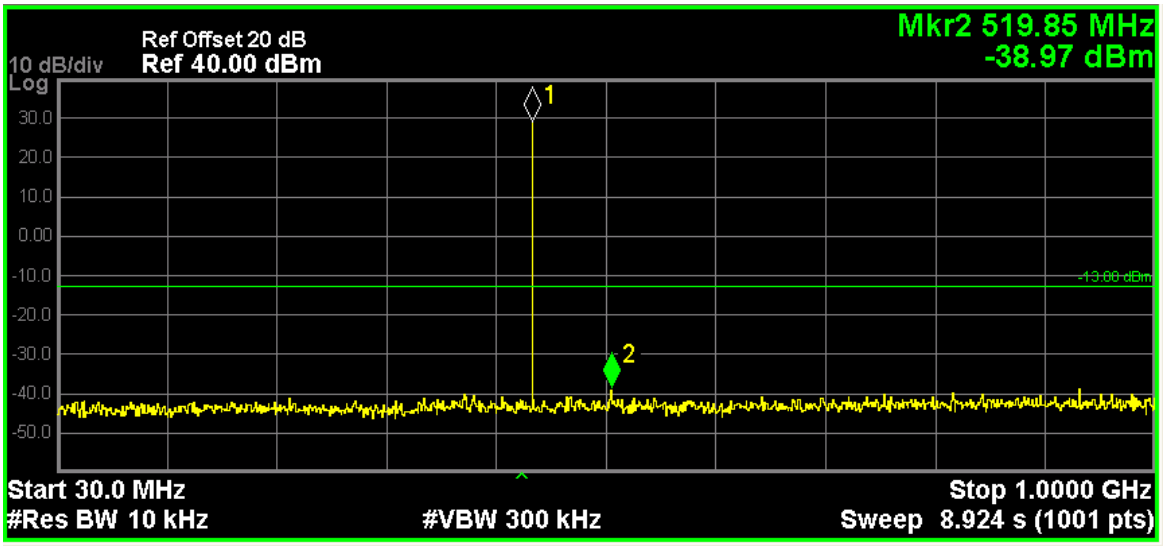
MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	403.45 MHz	30.069 dBm			
2	N	1	f	562.53 MHz	-40.724 dBm			
3								
4								

Note: Mark1 is carrier


Ref Offset 20 dB
10 dB/div
Log
Ref 30.00 dBm
Mkr1 3.536 GHz
-30.404 dBm
20.0
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-13.00 dBm
1
Start 1.000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 5.000 GHz
Sweep 6.667 ms (1001 pts)

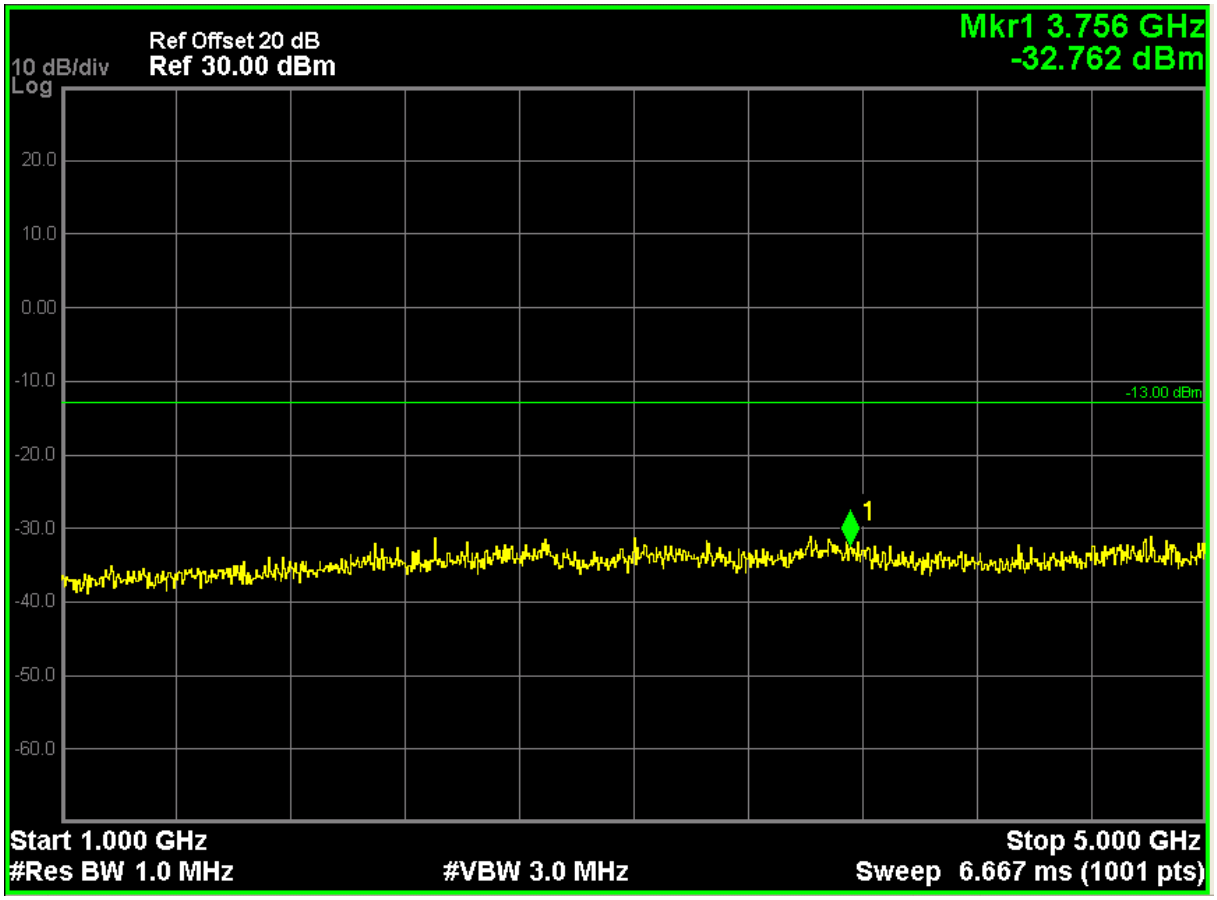
450MHz



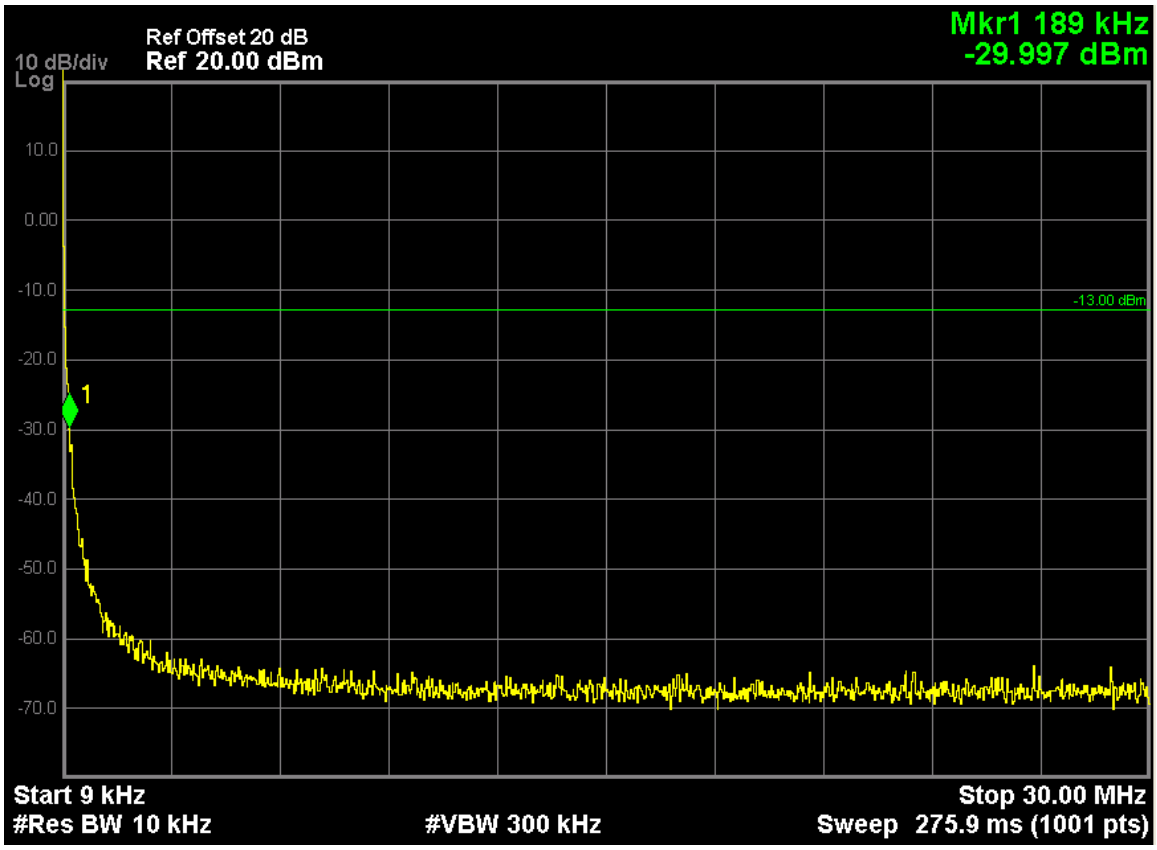


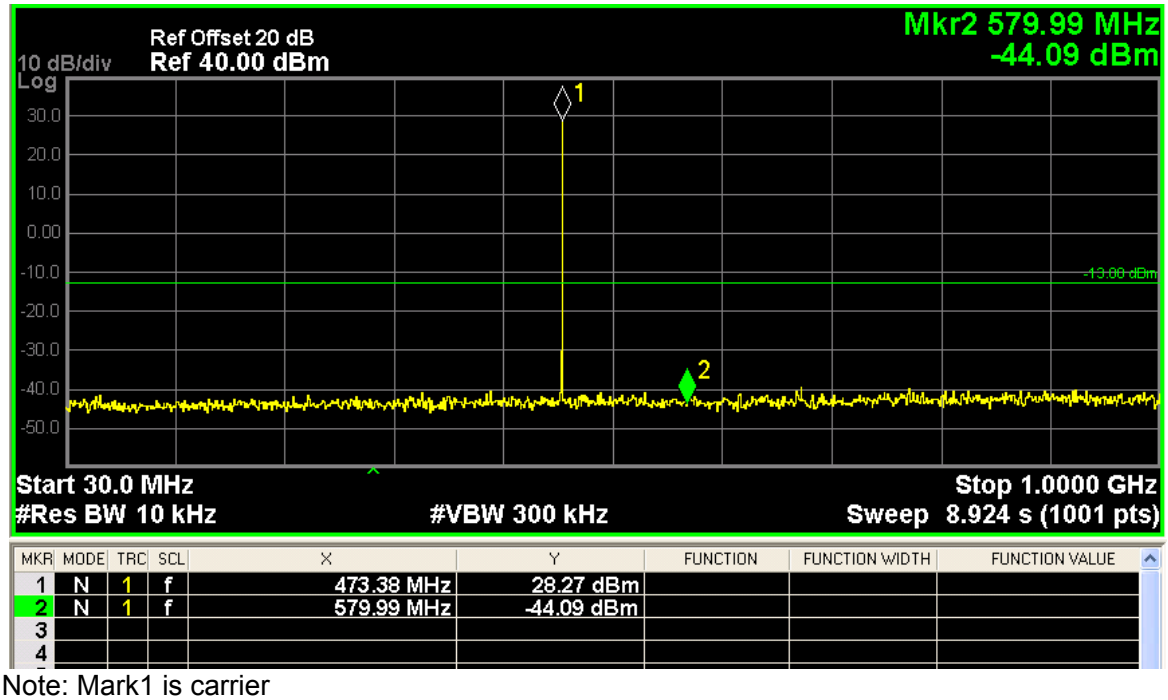
MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	450.01 MHz	28.65 dBm			
2	N	1	f	519.85 MHz	-38.97 dBm			
3								
4								

Note: Mark1 is carrier


Ref Offset 20 dB
10 dB/div
Log
Ref 30.00 dBm
Mkr1 3.756 GHz
-32.762 dBm
20.0
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-13.00 dBm
1
Start 1.000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 5.000 GHz
Sweep 6.667 ms (1001 pts)

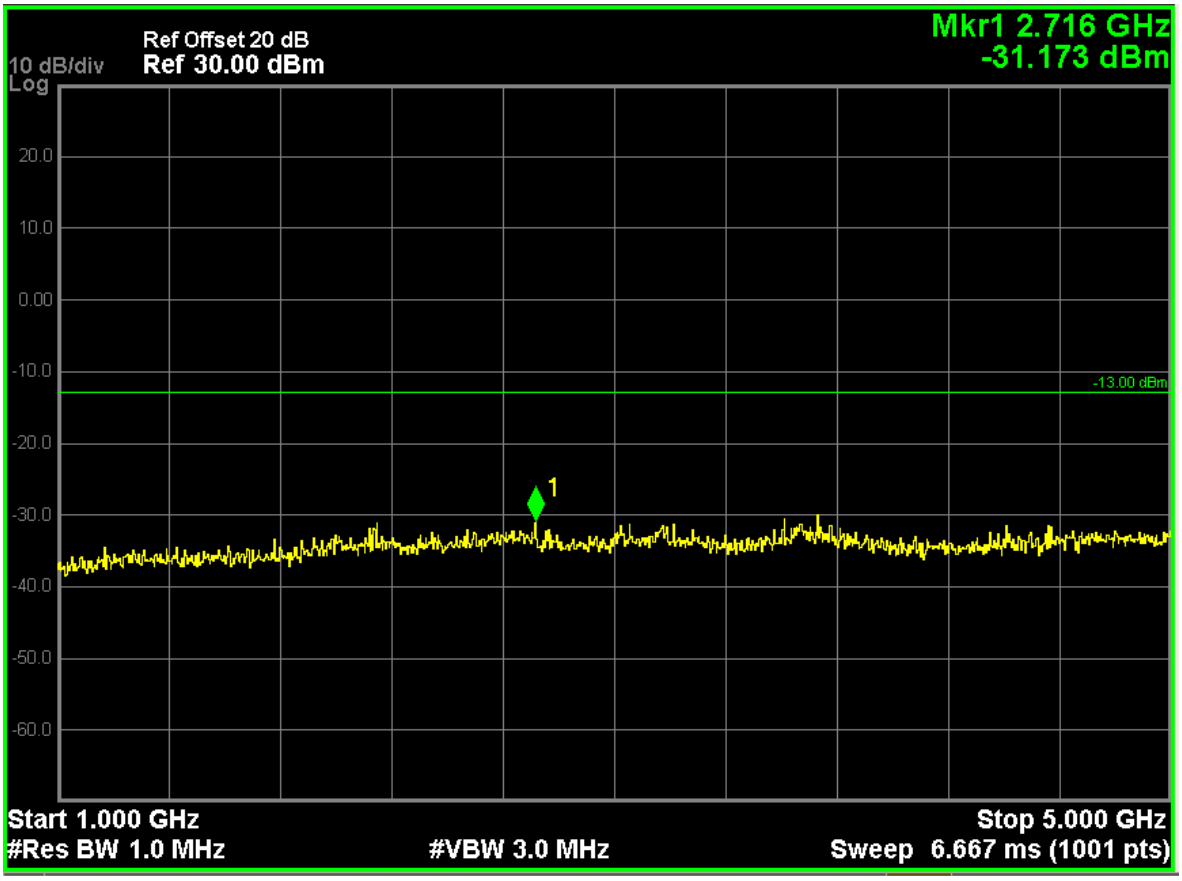
473MHz





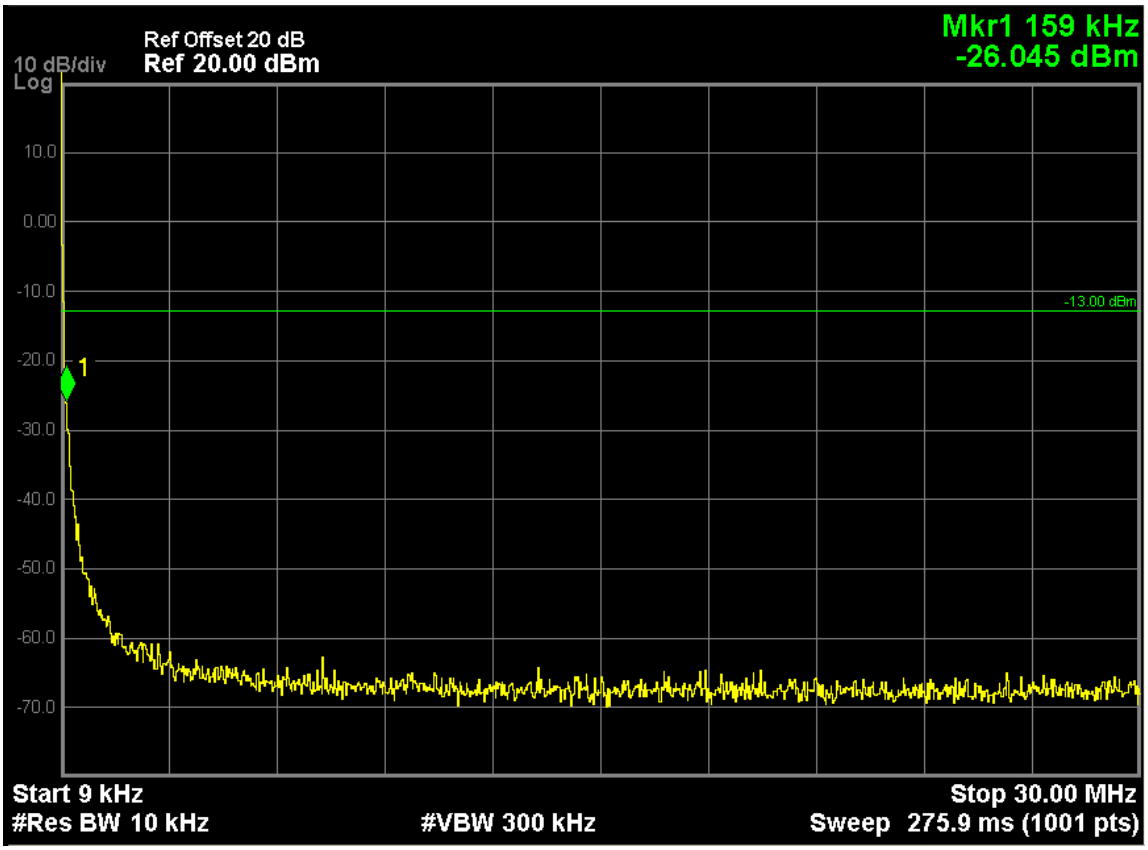
MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	473.38 MHz	28.27 dBm			
2	N	1	f	579.99 MHz	-44.09 dBm			
3								
4								

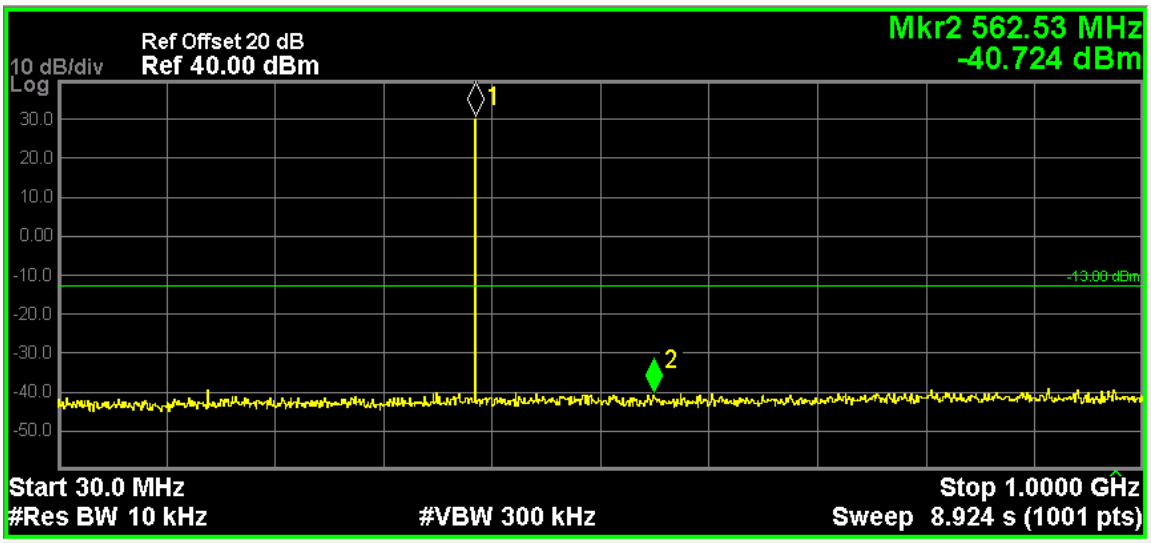
Note: Mark1 is carrier


Ref Offset 20 dB
10 dB/div
Log
Ref 30.00 dBm
Mkr1 2.716 GHz
-31.173 dBm
20.0
10.0
0.00
-10.0
-13.00 dBm
-20.0
-30.0
-40.0
-50.0
-60.0
1
Start 1.000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 5.000 GHz
Sweep 6.667 ms (1001 pts)

25 KHz Channel Separation, GMSK

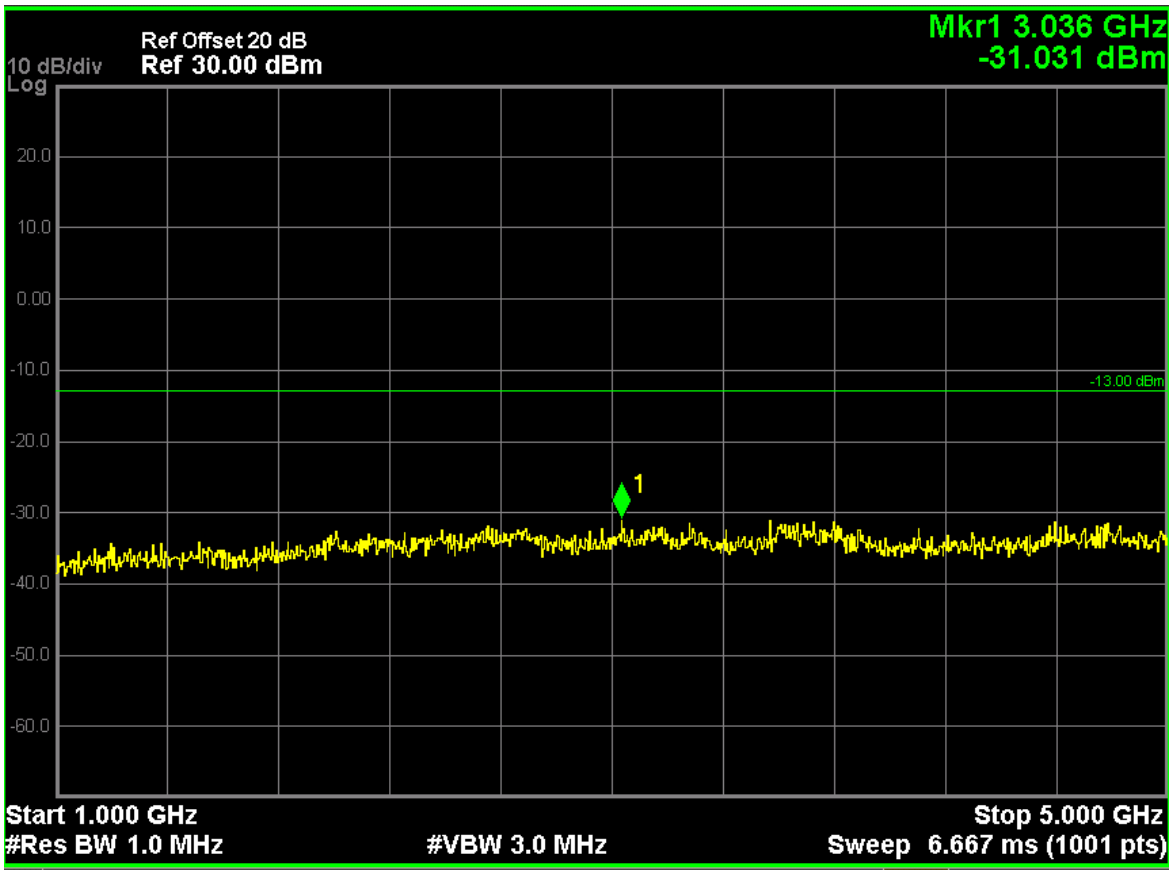
403MHz



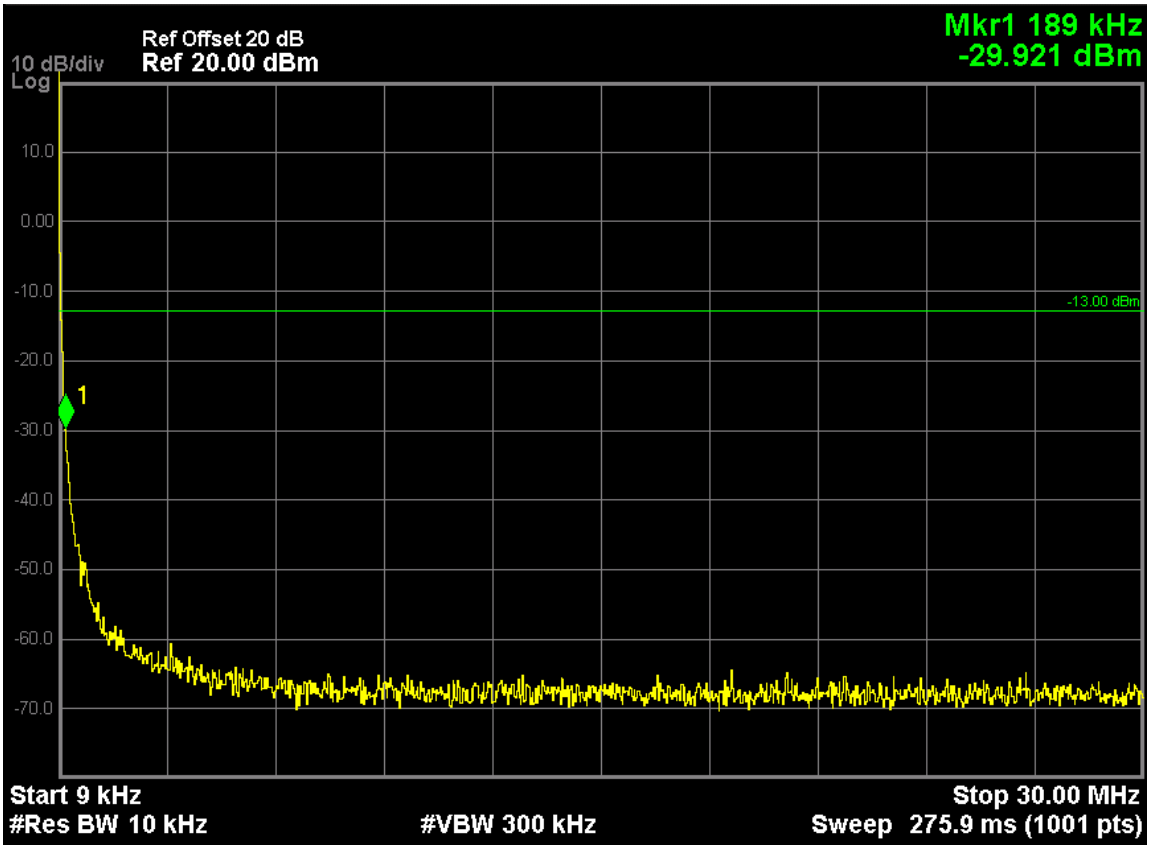


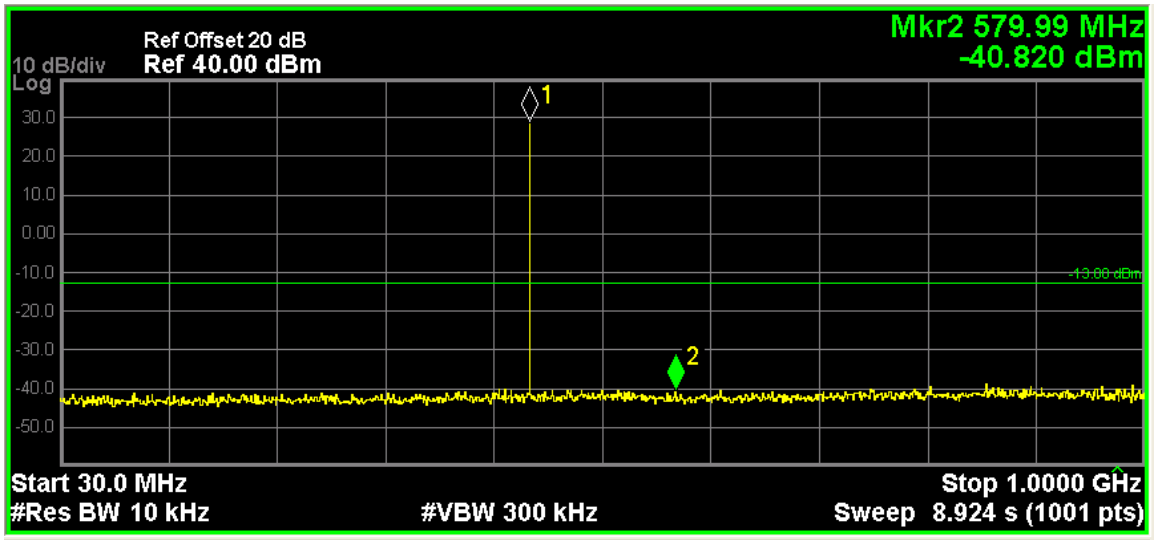
MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	403.45 MHz	30.069 dBm			
2	N	1	f	562.53 MHz	-40.724 dBm			
3								
4								
5								

Note: Mark1 is carrier


Ref Offset 20 dB
10 dB/div
Log
Ref 30.00 dBm
Mkr1 3.036 GHz
-31.031 dBm
20.0
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-13.00 dBm
1
Start 1.000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 5.000 GHz
Sweep 6.667 ms (1001 pts)

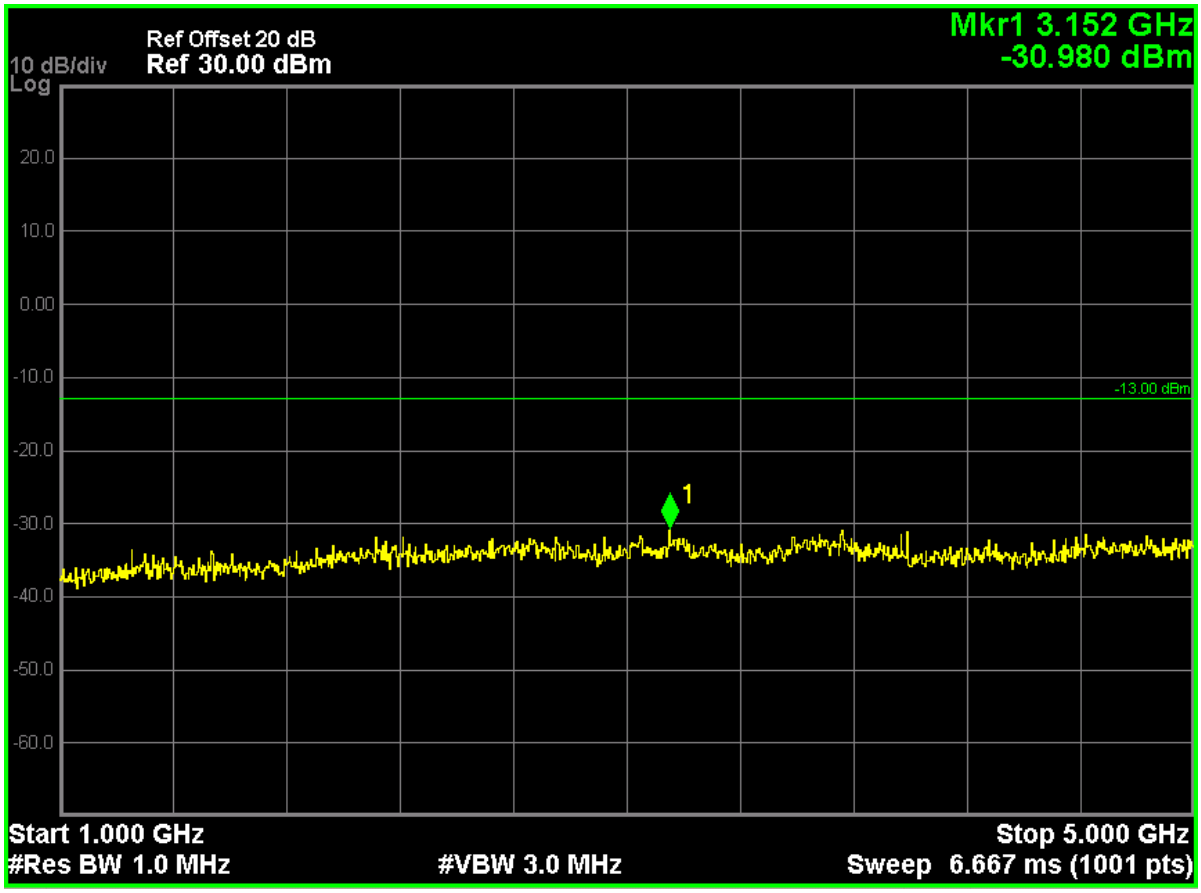
450MHz



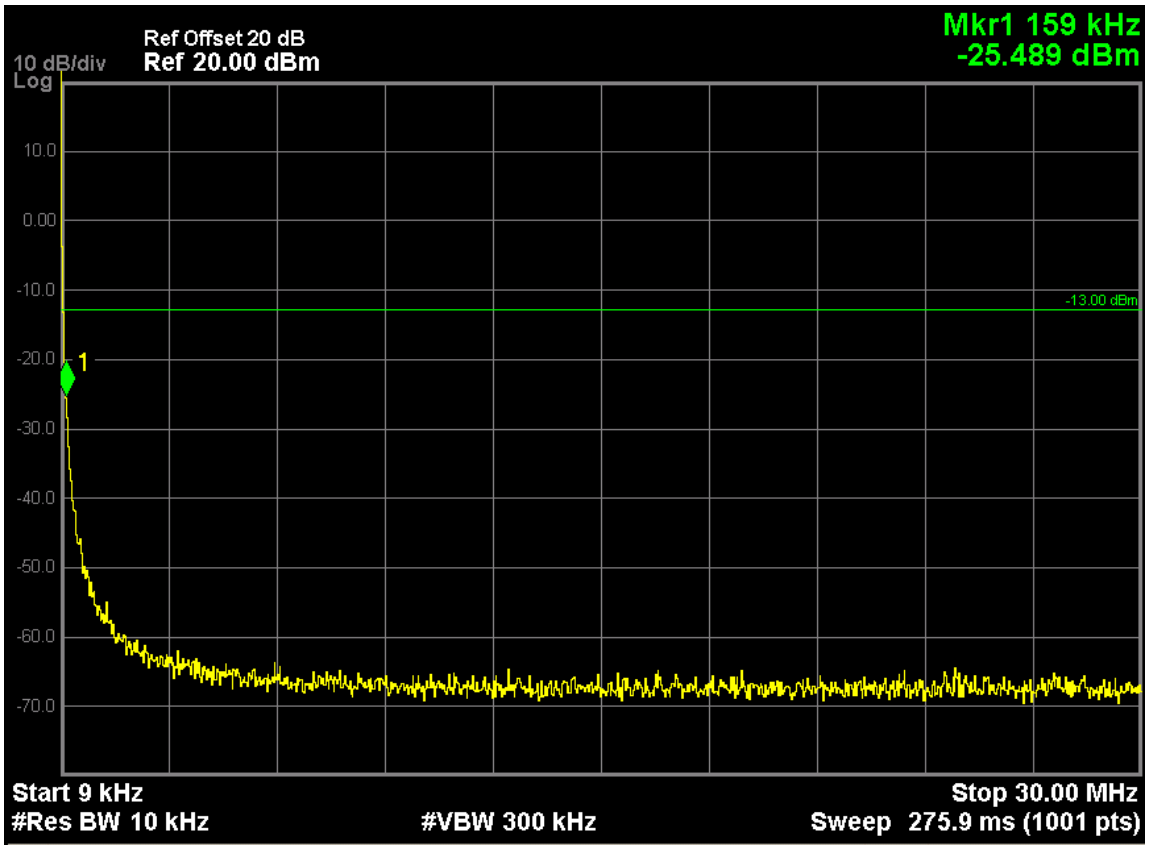


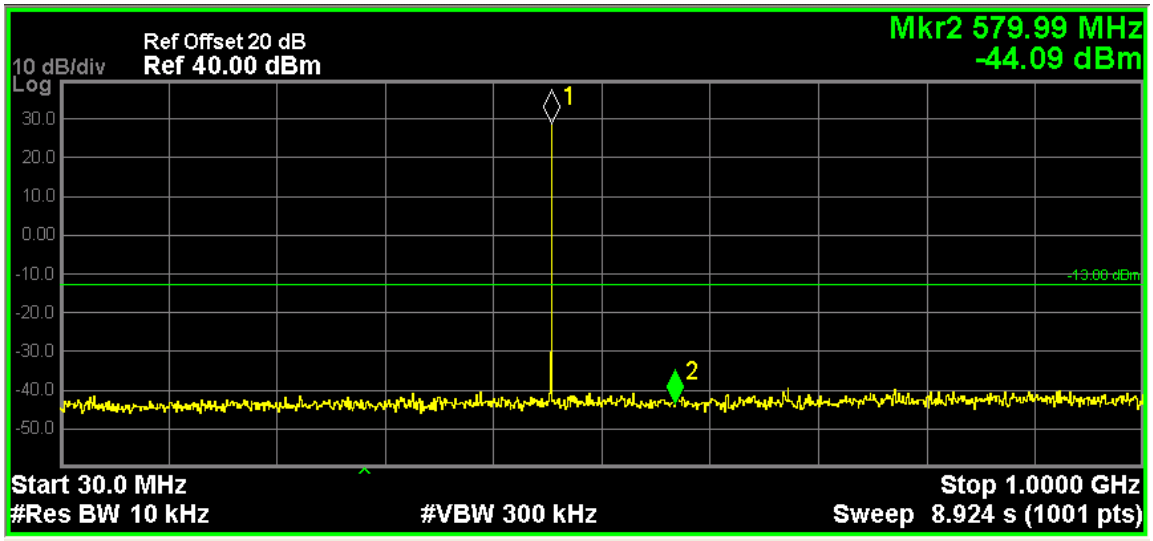
MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	450.01 MHz	28.498 dBm			
2	N	1	f	579.99 MHz	-40.820 dBm			
3								
4								
5								

Note: Mark1 is carrier


Ref Offset 20 dB
10 dB/div
Log
Ref 30.00 dBm
Mkr1 3.152 GHz
-30.980 dBm
20.0
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-13.00 dBm
1
Start 1.000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 5.000 GHz
Sweep 6.667 ms (1001 pts)

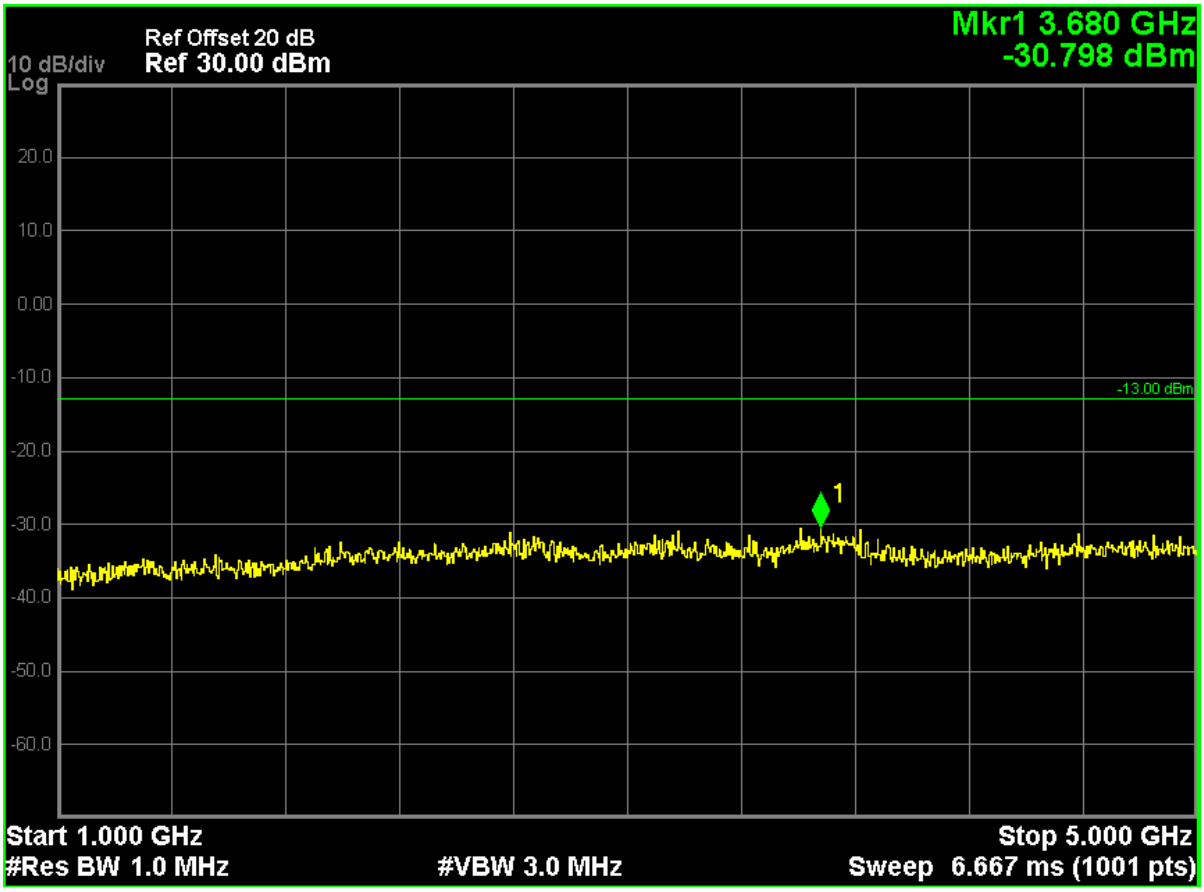
473MHz





MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	473.38 MHz	28.27 dBm			
2	N	1	f	579.99 MHz	-44.09 dBm			
3								
4								
5								

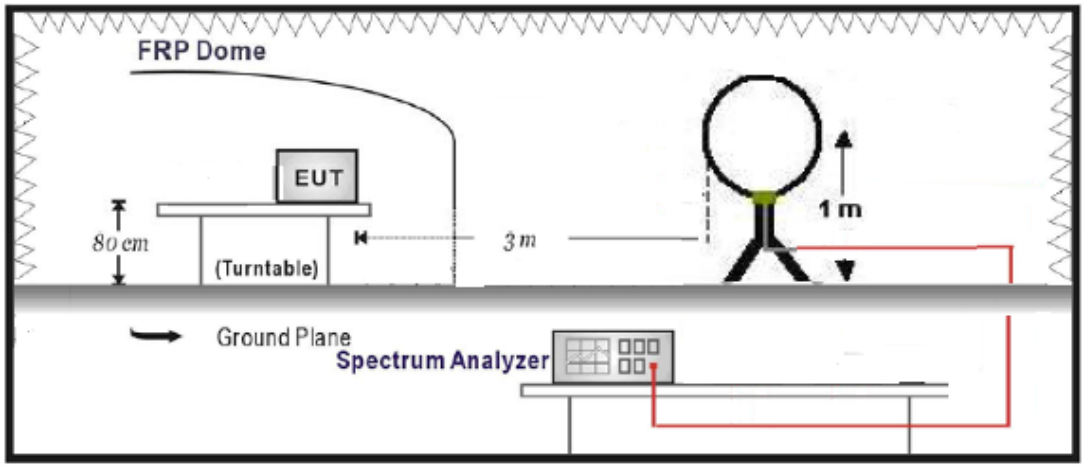
Note: Mark1 is carrier


Ref Offset 20 dB
10 dB/div
Log
Ref 30.00 dBm
Mkr1 3.680 GHz
-30.798 dBm
20.0
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-13.00 dBm
1
Start 1.000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 5.000 GHz
Sweep 6.667 ms (1001 pts)

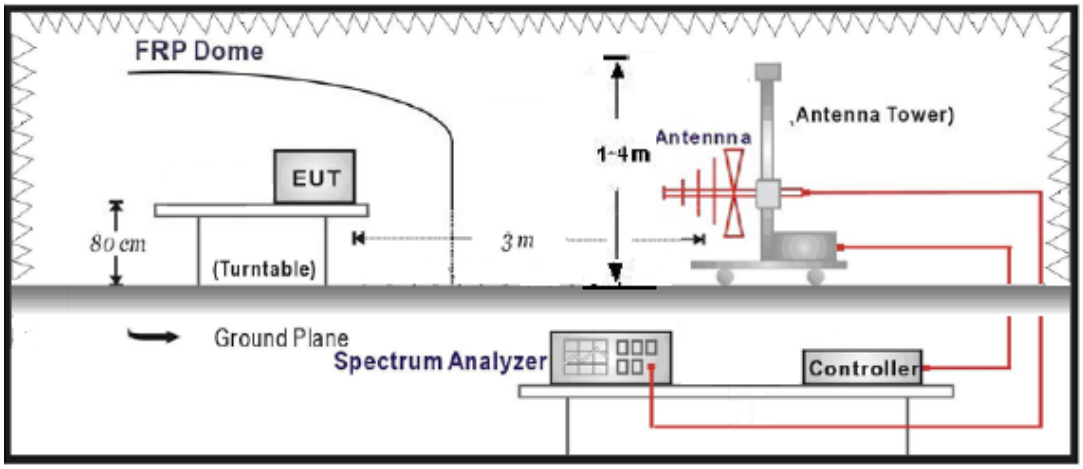
6. TRANSMITTER SPURIOUS RADIATED EMISSION

6.1 TEST SETUP LAYOUT

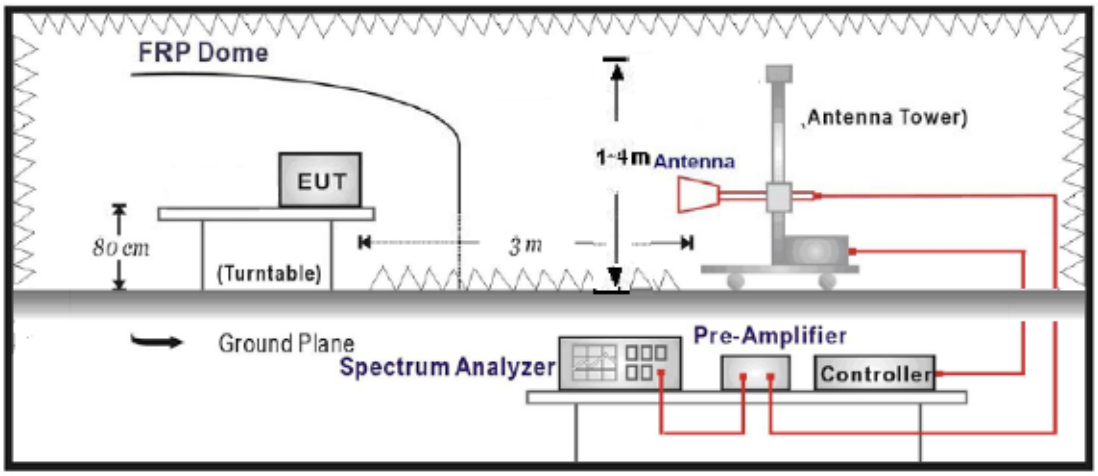
below 30MHz:



30MHz to 1GHz:



30MHz to 1GHz:



6.2 TEST PROCEDURE

1. Configure the EUT according to ANSI C63.4.
2. The EUT was placed on the top of the turn table 0.8 meter above ground.
3. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turn table.
4. Power on the EUT and all the supporting units.
5. The turn table was rotated 360 degrees to determine the position of the highest radiation.
6. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emission field strength of both horizontal and vertical polarization.
7. For each suspected emission, the antenna tower was scan (from 1m to 4m) and then the turn table was rotated (from 0 degrees to 360 degrees) to find the maximum reading.
8. Adjust the spectrum analyzer for the following settings:
   1) Resolution bandwidth = 10 KHz for spurious emissions below 1 GHz and 1MHz for spurious emissions above 1 GHz.
   2) Video bandwidth = 300 KHz for spurious emissions below 1 GHz, and 3 MHz for spurious emission above 1 GHz.
   3) Sweep Speed slow enough to maintain measurement calibration.
   4) Detector Mode = Positive Peak.
9. Remove the transmitter and replace it with a broadband substitution antenna.
10. With the substitution antennas at horizontally polarized and with the signal generator tuned to a particular spurious frequency, raise and lower the test antenna to obtain a maximum reading at the spectrum analyzer. Adjust the level of the signal generator output until the previously recorded maximum reading (item 7). This should be done carefully repeating the adjustment of the test antenna and generator output.
11. P_d (dBm)=P_g (dBm)-cable loss (dB) + antenna gain (dBi). P_d is the dipole equivalent power and P_g is the generator output power into the substitution antenna.
12. For 12.5 KHz channel separation, on any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in KHz) for of more than 12.5 KHz: at least 50+10 log(P) dB or 70 dB, whichever is lesser attenuation.
13. For 25 KHz channel separation, on any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth, at least 43+10 log(P) dB attenuation.

6.3 TEST RESULTS

12.5KHz Channel Separation, 4FSK, 403MHz

(1) 9KHz to 30MHz

The low frequency, which started from 9KHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line, and that was not reported per 2.1057 (c).

(2) 30MHz to 1GHz

Frequency (MHz)	Ant. Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
295.63	H	-43.9	2.12	-2.48	-48.50	-20.00	28.5
295.63	V	-42.05	2.12	-2.48	-46.65	-20.00	26.65
940.54	H	-31.65	4.01	-2.57	-38.23	-20.00	18.23
940.54	V	-30.84	4.01	-2.57	-37.42	-20.00	17.42

(3) above 1GHz

Frequency (MHz)	Ant. Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
1408.66	H	-31.42	6.12	-2.59	-40.13	-20.00	20.13
1408.66	V	-30.55	6.12	-2.59	-39.26	-20.00	19.26
2822.12	H	-31.19	7.41	-2.86	-41.46	-20.00	21.46
2822.12	V	-30.72	7.41	-2.86	-40.99	-20.00	20.99

12.5KHz Channel Separation, 4FSK, 450MHz

(1) 9KHz to 30MHz

The low frequency, which started from 9KHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line, and that was not reported per 2.1057 (c).

(2) 30MHz to 1GHz

Frequency (MHz)	Ant. Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
298.92	H	-38.66	2.12	-2.48	-43.26	-20.00	23.26
298.92	V	-38.41	2.12	-2.48	-43.01	-20.00	23.01
920.35	H	-32.69	4.01	-2.57	-39.27	-20.00	19.27
920.35	V	-32.11	4.01	-2.57	-38.69	-20.00	18.69

(3) above 1GHz

Frequency (MHz)	Ant. Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
1835.67	H	-24.93	6.12	-2.59	-33.64	-20.00	13.64
1835.67	V	-24.18	6.12	-2.59	-32.89	-20.00	12.89
2298.61	H	-30.37	7.06	-2.86	-40.29	-20.00	20.29
2298.61	V	-29.94	7.06	-2.86	-39.86	-20.00	19.86

12.5KHz Channel Separation, 4FSK, 473MHz

(1) 9KHz to 30MHz

The low frequency, which started from 9KHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line, and that was not reported per 2.1057 (c).

(2) 30MHz to 1GHz

Frequency (MHz)	Ant. Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
263.64	H	-40.77	2.12	-2.48	-45.37	-20.00	25.37
263.64	V	-40.38	2.12	-2.48	-44.98	-20.00	24.98
940.55	H	-32.25	4.01	-2.57	-38.83	-20.00	18.83
940.55	V	-31.44	4.01	-2.57	-38.02	-20.00	18.02

(3) above 1GHz

Frequency (MHz)	Ant. Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
1879.81	H	-32.54	6.12	-2.59	-41.25	-20.00	21.25
1879.81	V	-31.97	6.12	-2.59	-40.68	-20.00	20.68
2822.12	H	-33	7.41	-2.86	-43.27	-20.00	23.27
2822.12	V	-32.74	7.41	-2.86	-43.01	-20.00	23.01

12.5KHz Channel Separation, GMSK, 403MHz

(1) 9KHz to 30MHz

The low frequency, which started from 9KHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line, and that was not reported per 2.1057 (c).

(2) 30MHz to 1GHz

Frequency (MHz)	Ant. Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
263.71	H	-42.03	2.12	-2.48	-46.63	-20.00	26.63
263.71	V	-40.78	2.12	-2.48	-45.38	-20.00	25.38
812.34	H	-33.11	4.01	-2.57	-39.69	-20.00	19.69
812.34	V	-32	4.01	-2.57	-38.58	-20.00	18.58

(3) above 1GHz

Frequency (MHz)	Ant. Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
2028.68	H	-32.8	6.95	-2.78	-42.53	-20.00	22.53
2028.68	V	-32.5	6.85	-2.78	-42.13	-20.00	22.13
4057.59	H	-34.03	8.92	-3.28	-46.23	-20.00	26.23
4057.59	V	-33.67	8.92	-3.28	-45.87	-20.00	25.87

12.5KHz Channel Separation, GMSK, 450MHz

(1) 9KHz to 30MHz

The low frequency, which started from 9KHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line, and that was not reported per 2.1057 (c).

(2) 30MHz to 1GHz

Frequency (MHz)	Ant. Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
297.54	H	-38.61	2.12	-2.48	-43.21	-20.00	23.21
297.54	V	-38.71	2.12	-2.48	-43.31	-20.00	23.31
812.67	H	-33.28	4.01	-2.57	-39.86	-20.00	19.86
812.67	V	-32.46	4.01	-2.57	-39.04	-20.00	19.04

(3) above 1GHz

Frequency (MHz)	Ant. Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
2028.75	H	-31.5	6.95	-2.78	-41.23	-20.00	21.23
2028.75	V	-31.24	6.85	-2.78	-40.87	-20.00	20.87
4057.68	H	-30.13	8.92	-3.28	-42.33	-20.00	22.33
4057.68	V	-29.37	8.92	-3.28	-41.57	-20.00	21.57

12.5KHz Channel Separation, GMSK, 473MHz

(1) 9KHz to 30MHz

The low frequency, which started from 9KHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line, and that was not reported per 2.1057 (c).

(2) 30MHz to 1GHz

Frequency (MHz)	Ant. Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
297.25	H	-38.96	2.12	-2.48	-43.56	-20.00	23.56
297.25	V	-37.45	2.12	-2.48	-42.05	-20.00	22.05
836.23	H	-33.1	4.01	-2.57	-39.68	-20.00	19.68
836.23	V	-32.19	4.01	-2.57	-38.77	-20.00	18.77

(3) above 1GHz

Frequency (MHz)	Ant. Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
1673.07	H	-31.97	6.12	-2.59	-40.68	-20.00	20.68
1673.07	V	-31.15	6.12	-2.59	-39.86	-20.00	19.86
3764.52	H	-31.14	8.13	-2.86	-42.13	-20.00	22.13
3764.52	V	-30.6	8.13	-2.86	-41.59	-20.00	21.59

25KHz Channel Separation, 4FSK, 403MHz

(1) 9KHz to 30MHz

The low frequency, which started from 9KHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line, and that was not reported per 2.1057 (c).

(2) 30MHz to 1GHz

Frequency (MHz)	Ant. Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
283.62	H	-42.12	2.12	-2.48	-46.72	-13.00	33.72
283.62	V	-41.07	2.12	-2.48	-45.67	-13.00	32.67
851.04	H	-26.65	4.01	-2.57	-33.23	-13.00	20.23
851.04	V	-25.55	4.01	-2.57	-32.13	-13.00	19.13

(3) above 1GHz

Frequency (MHz)	Ant. Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
1646.13	H	-30.91	6.12	-2.59	-39.62	-13.00	26.62
1646.13	V	-30.3	6.12	-2.59	-39.01	-13.00	26.01
2962.34	H	-32.24	7.45	-2.67	-42.36	-13.00	29.36
2962.34	V	-31.7	7.45	-2.67	-41.82	-13.00	28.82

25KHz Channel Separation, 4FSK, 450MHz

(1) 9KHz to 30MHz

The low frequency, which started from 9KHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line, and that was not reported per 2.1057 (c).

(2) 30MHz to 1GHz

Frequency (MHz)	Ant. Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
286.62	H	-41.49	2.12	-2.48	-46.09	-13.00	33.09
286.62	V	-41.14	2.12	-2.48	-45.74	-13.00	32.74
873.24	H	-32.34	4.01	-2.57	-38.92	-13.00	25.92
873.24	V	-31.54	4.01	-2.57	-38.12	-13.00	25.12

(3) above 1GHz

Frequency (MHz)	Ant. Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
1809.21	H	-31.41	6.12	-2.59	-40.12	-13.00	27.12
1809.21	V	-30.97	6.12	-2.59	-39.68	-13.00	26.68
3149.03	H	-32.22	8.13	-2.86	-43.21	-13.00	30.21
3149.03	V	-32.06	8.13	-2.86	-43.05	-13.00	30.05

25KHz Channel Separation, 4FSK, 473MHz

(1) 9KHz to 30MHz

The low frequency, which started from 9KHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line, and that was not reported per 2.1057 (c).

(2) 30MHz to 1GHz

Frequency (MHz)	Ant. Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
268.42	H	-40.72	2.12	-2.48	-45.32	-13.00	32.32
268.42	V	-39.89	2.12	-2.48	-44.49	-13.00	31.49
845.44	H	-33.28	4.01	-2.57	-39.86	-13.00	26.86
845.44	V	-32.47	4.01	-2.57	-39.05	-13.00	26.05

(3) above 1GHz

Frequency (MHz)	Ant. Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
1798.65	H	-30	6.12	-2.59	-38.71	-13.00	25.71
1798.65	V	-29.31	6.12	-2.59	-38.02	-13.00	25.02
2689.68	H	-32.01	7.41	-2.67	-42.09	-13.00	29.09
2689.68	V	-31.45	7.41	-2.67	-41.53	-13.00	28.53

25KHz Channel Separation, GMSK, 403MHz

(1) 9KHz to 30MHz

The low frequency, which started from 9KHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line, and that was not reported per 2.1057 (c).

(2) 30MHz to 1GHz

Frequency (MHz)	Ant. Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
263.83	H	-39.63	2.12	-2.48	-44.23	-13.00	31.23
263.83	V	-39.29	2.12	-2.48	-43.89	-13.00	30.89
812.67	H	-32.98	4.01	-2.57	-39.56	-13.00	26.56
812.67	V	-32.39	4.01	-2.57	-38.97	-13.00	25.97

(3) above 1GHz

Frequency (MHz)	Ant. Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
1715.21	H	-27.58	6.12	-2.59	-36.29	-13.00	23.29
1715.21	V	-27.25	6.12	-2.59	-35.96	-13.00	22.96
2943.42	H	-35.2	7.45	-2.67	-45.32	-13.00	32.32
2943.42	V	-34.74	7.45	-2.67	-44.86	-13.00	31.86

25KHz Channel Separation, GMSK, 450MHz

(1) 9KHz to 30MHz

The low frequency, which started from 9KHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line, and that was not reported per 2.1057 (c).

(2) 30MHz to 1GHz

Frequency (MHz)	Ant. Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
297.31	H	-43.63	2.12	-2.48	-48.23	-13.00	35.23
297.31	V	-43.05	2.12	-2.48	-47.65	-13.00	34.65
812.35	H	-33.1	4.01	-2.57	-39.68	-13.00	26.68
812.35	V	-32.18	4.01	-2.57	-38.76	-13.00	25.76

(3) above 1GHz

Frequency (MHz)	Ant. Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
1625.01	H	-32.32	6.12	-2.59	-41.03	-13.00	28.03
1625.01	V	-32.11	6.12	-2.59	-40.82	-13.00	27.82
2841.36	H	-33.6	7.41	-2.67	-43.68	-13.00	30.68
2841.36	V	-32.96	7.41	-2.67	-43.04	-13.00	30.04

25KHz Channel Separation, GMSK, 473MHz

(1) 9KHz to 30MHz

The low frequency, which started from 9KHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line, and that was not reported per 2.1057 (c).

(2) 30MHz to 1GHz

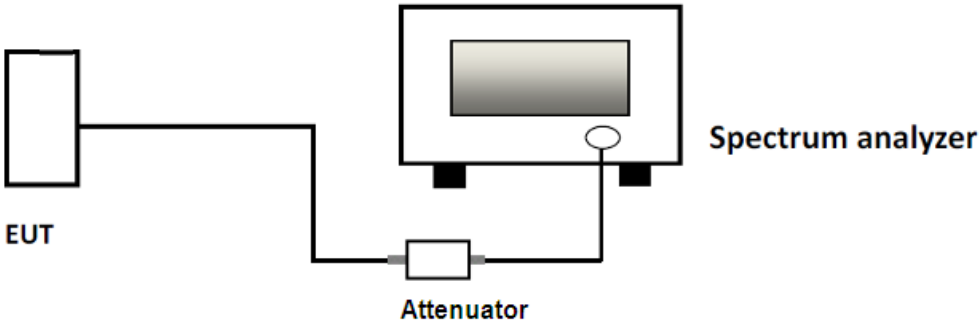
Frequency (MHz)	Ant. Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
263.82	H	-40.55	2.12	-2.48	-45.15	-13.00	32.15
263.82	V	-39.77	2.12	-2.48	-44.37	-13.00	31.37
860.90	H	-33.31	4.01	-2.57	-39.89	-13.00	26.89
860.90	V	-32.54	4.01	-2.57	-39.12	-13.00	26.12

(3) above 1GHz

Frequency (MHz)	Ant. Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
1721.15	H	-29.2	6.12	-2.59	-37.91	-13.00	24.91
1721.15	V	-28.63	6.12	-2.59	-37.34	-13.00	24.34
2581.73	H	-31.97	7.25	-2.67	-41.89	-13.00	28.89
2581.73	V	-31.3	7.25	-2.67	-41.22	-13.00	28.22

7. TRANSMITTER SPECTRUM MASK

7.1 TEST SETUP LAYOUT



7.2 TEST PROCEDURE

1. The transmitter output is connected to the spectrum analyzer through an attenuator.
2. Set RBW of spectrum analyzer to 300Hz and VBW to 1KHz.
3. Mark the frequency with maximum peak power as the center of the display of the spectrum.
4. Set the span to 120KHz and sweep time to Auto.
5. Record the power spectral and compare to the Mask.
6. Limit according to FCC §90.210 and EUT performance, 12.5 KHz: Emission Mask D, 25 KHz: Emission Mask C.

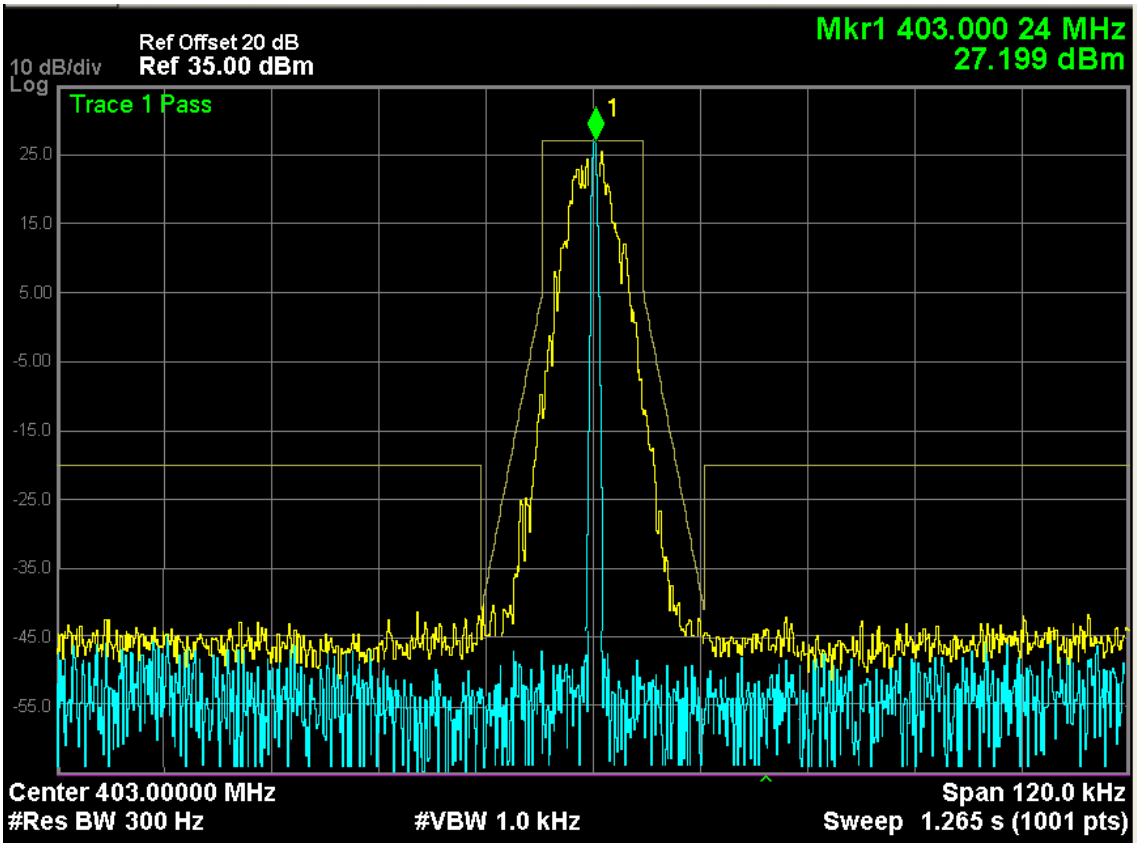
Applicable Emission Masks		
Frequency Band (MHz)	**Mask for Equipment with Audio Low Pass Filter**	**Mask for Equipment Without Audio Low Pass Filter**
Below 25 [1]	A or B	A or C
25–50	B	C
72–76	B	C
150–174 [2]	B, D, or E	C, D, or E
150 Paging-only	B	C
220–222	F	F
421–512 [2]	B, D, or E	C, D, or E
450 Paging-only	B	G
806–809/851–854	B	H
809–824/854–869 [3]	B	G
896–901/935–940	I	J
902–928	K	K
929–930	B	G
4940–4990 MHz	L or M	L or M
5850–5925 [4]		
All other bands	B	C

1 Equipment using single sideband J3E emission must meet the requirements of Emission Mask A. Equipment using other emissions must meet the requirements of Emission Mask B or C, as applicable.
2 Equipment designed to operate with a 25 kHz channel bandwidth must meet the requirements of Emission Mask B or C, as applicable. Equipment designed to operate with a 12.5 kHz channel bandwidth must meet the requirements of Emission Mask D, and equipment designed to operate with a 6.25 kHz channel bandwidth must meet the requirements of Emission Mask E.
3 Equipment used in this licensed to EA or non-EA systems shall comply with the emission mask provisions of §90.691.
4 DSRCS Roadside Units equipment in the 5850–5925 MHz band is governed under subpart M of this part.

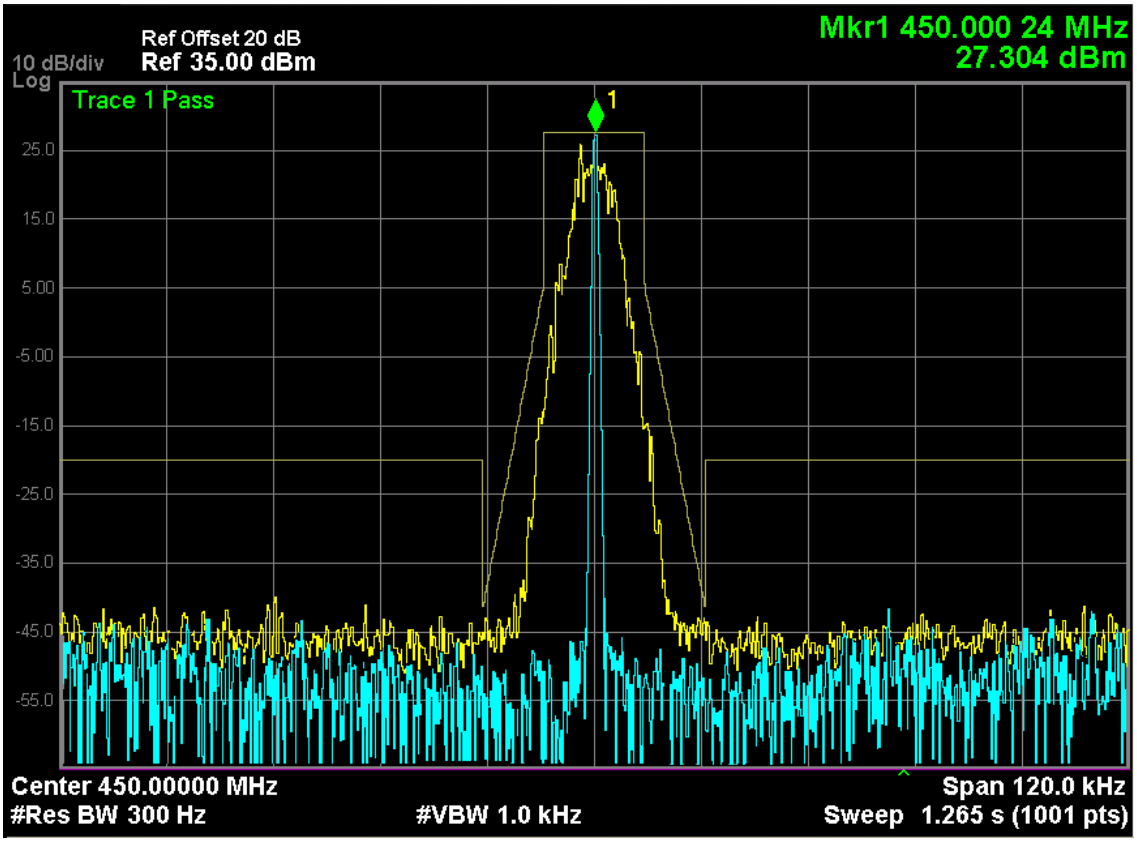
7.3 TEST RESULTS

12.5 KHz Channel Separation, 4FSK

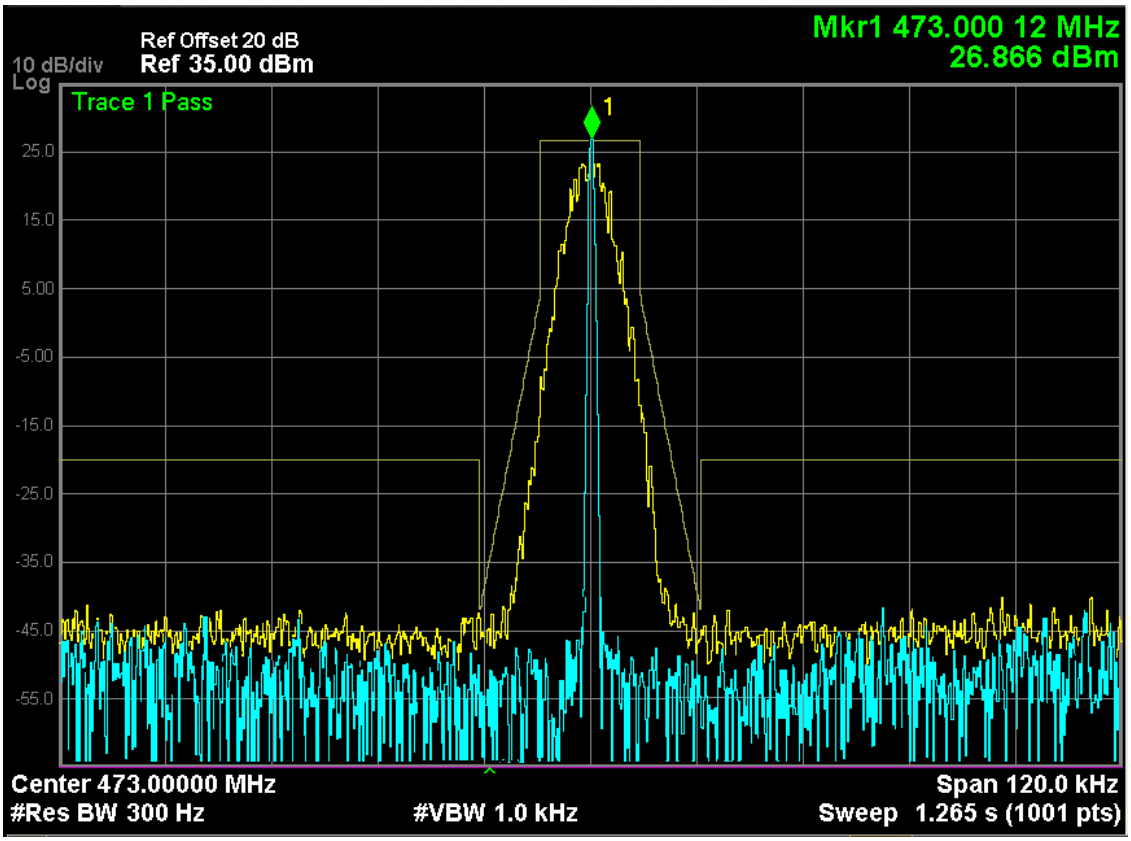
403MHz



450MHz

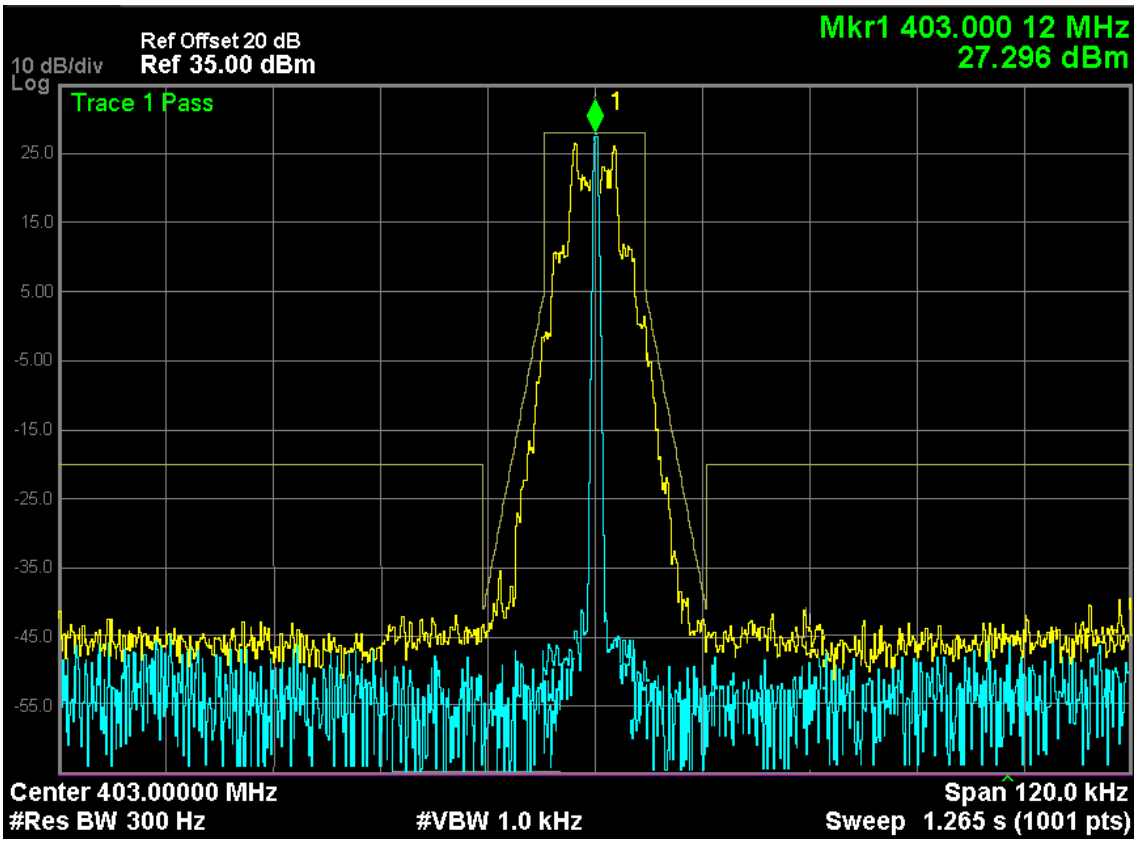


473MHz

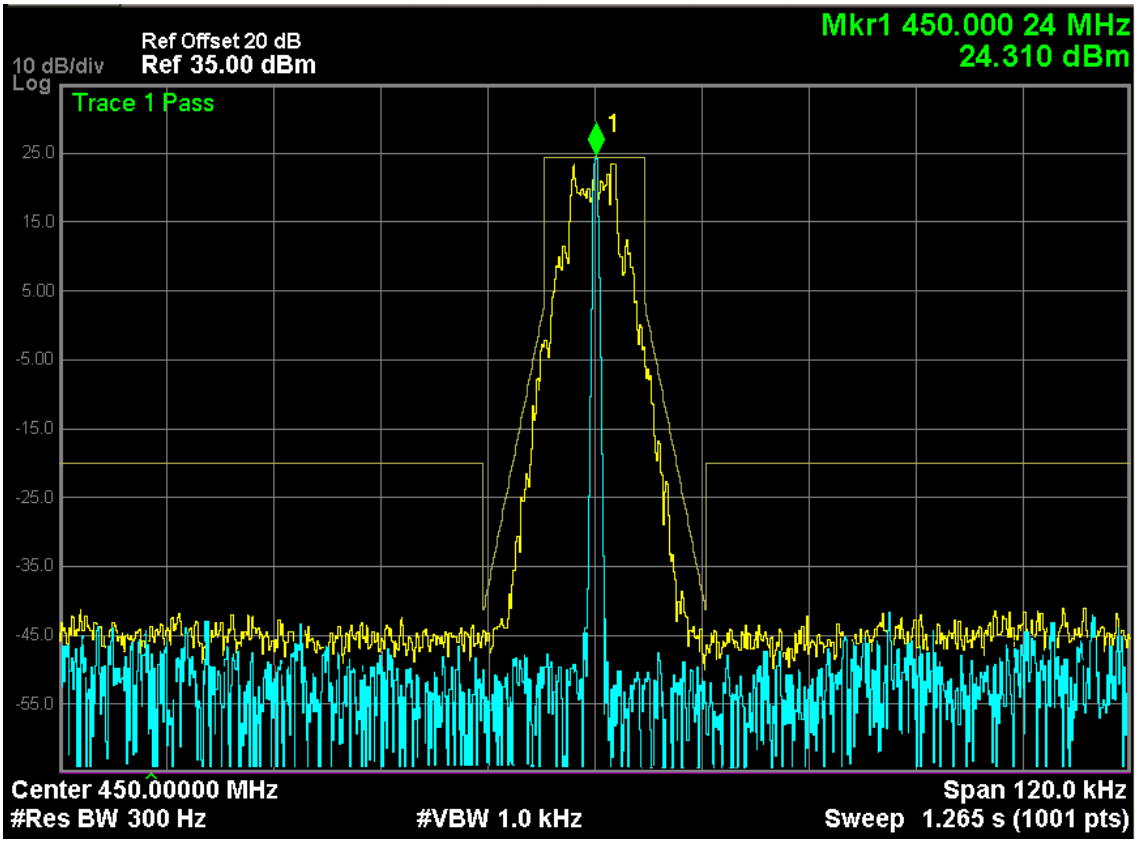

Ref Offset 20 dB
10 dB/div
Log
Ref 35.00 dBm
Mkr1 473.000 12 MHz
26.866 dBm
Trace 1 Pass
1
25.0
15.0
5.00
-5.00
-15.0
-25.0
-35.0
-45.0
-55.0
Center 473.00000 MHz
#Res BW 300 Hz
#VBW 1.0 kHz
Span 120.0 kHz
Sweep 1.265 s (1001 pts)

12.5 KHz Channel Separation, GMSK

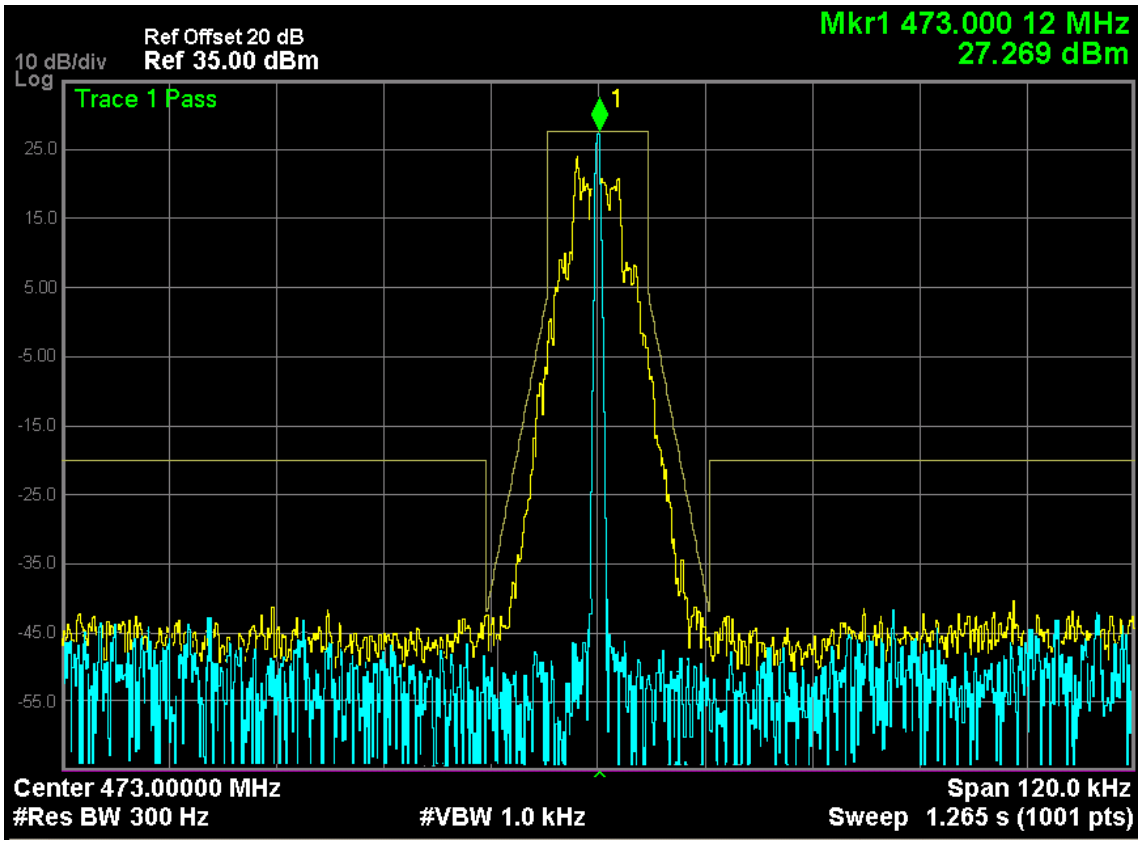
403MHz



450MHz

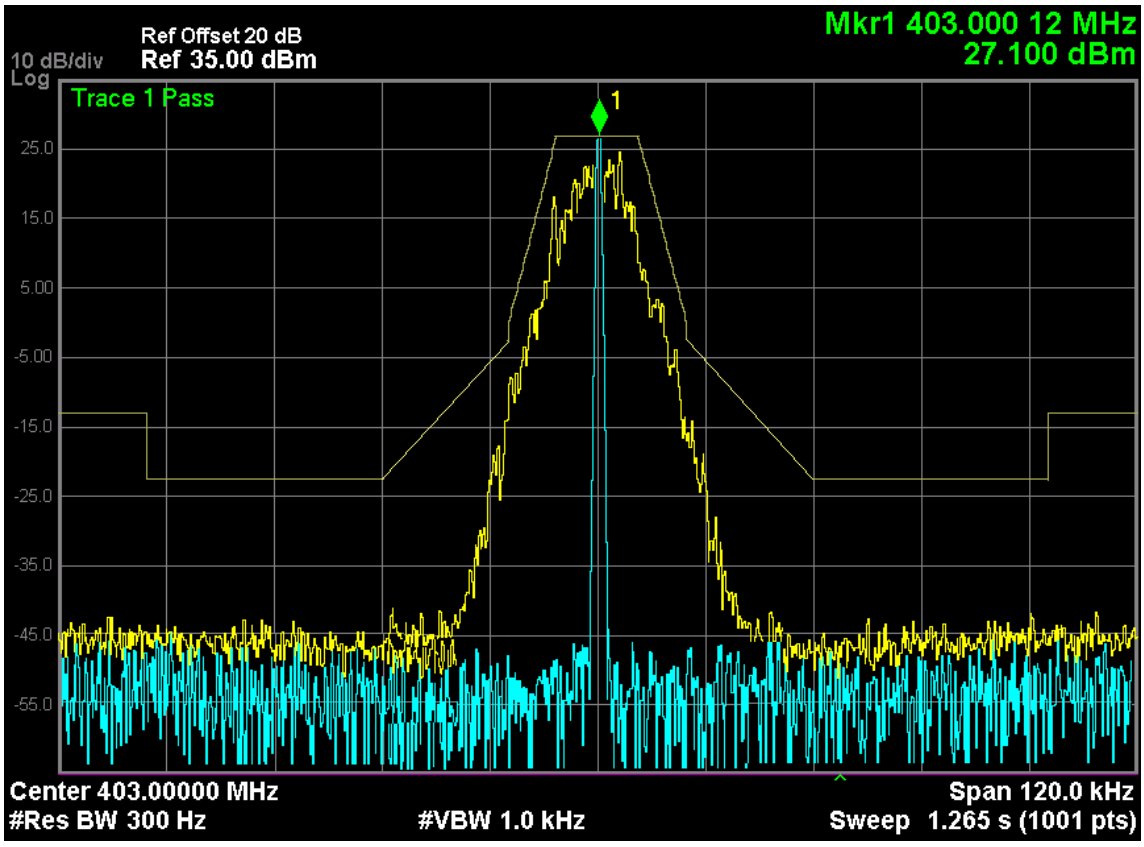


473MHz

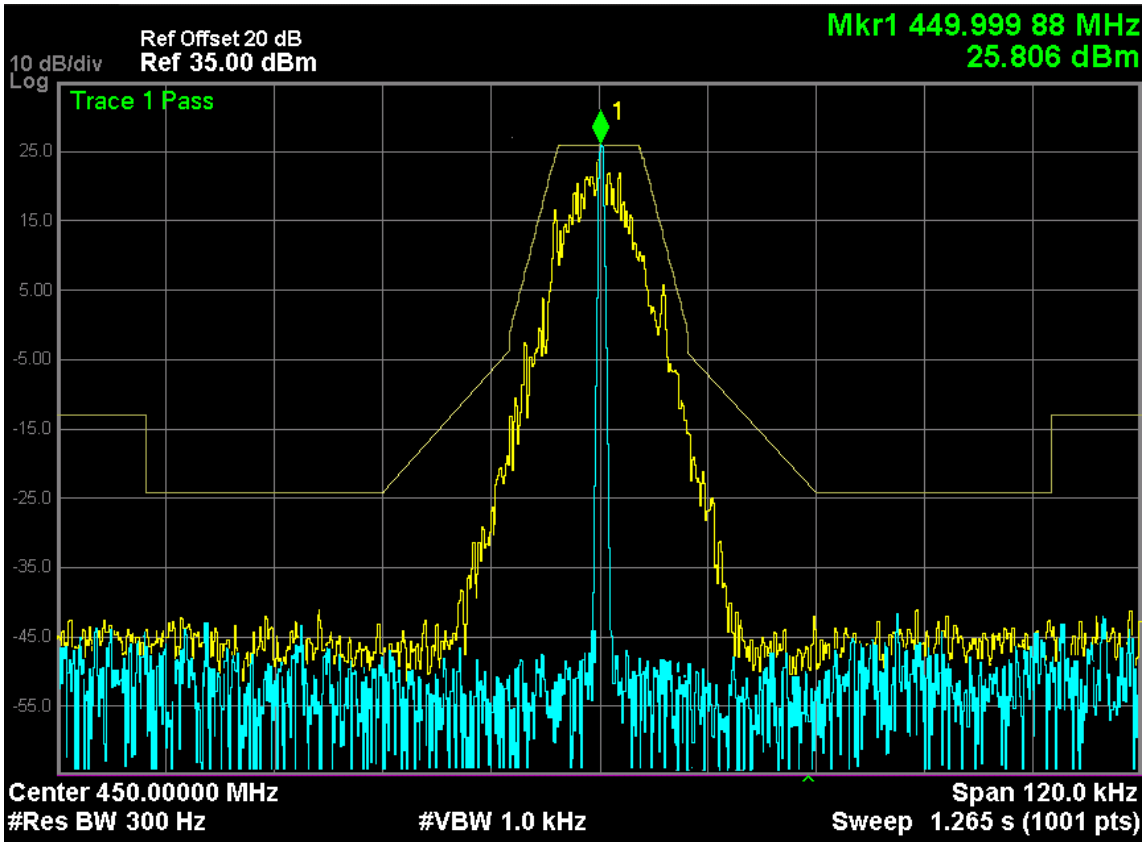

Ref Offset 20 dB
10 dB/div
Log
Ref 35.00 dBm
Mkr1 473.000 12 MHz
27.269 dBm
Trace 1 Pass
1
25.0
15.0
5.00
-5.00
-15.0
-25.0
-35.0
-45.0
-55.0
Center 473.00000 MHz
#Res BW 300 Hz
#VBW 1.0 kHz
Span 120.0 kHz
Sweep 1.265 s (1001 pts)

25 KHz Channel Separation, 4FSK

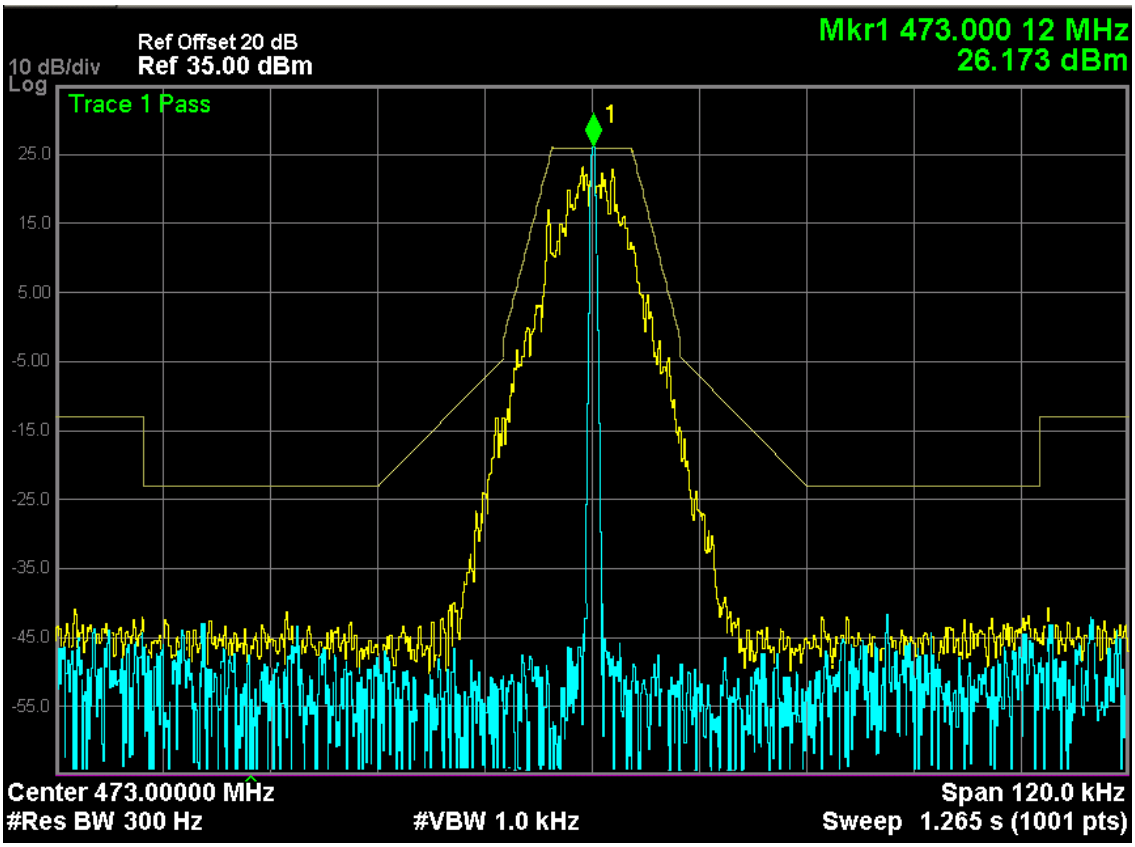
403MHz



450MHz

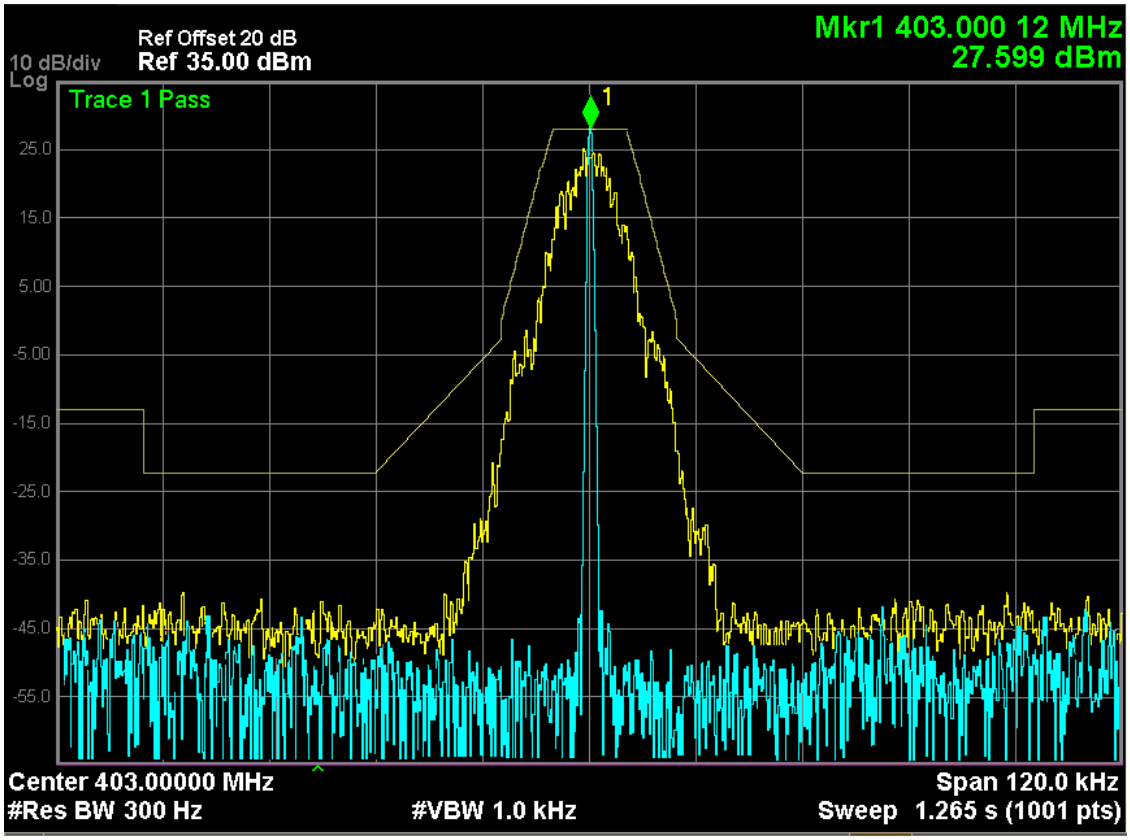


473MHz

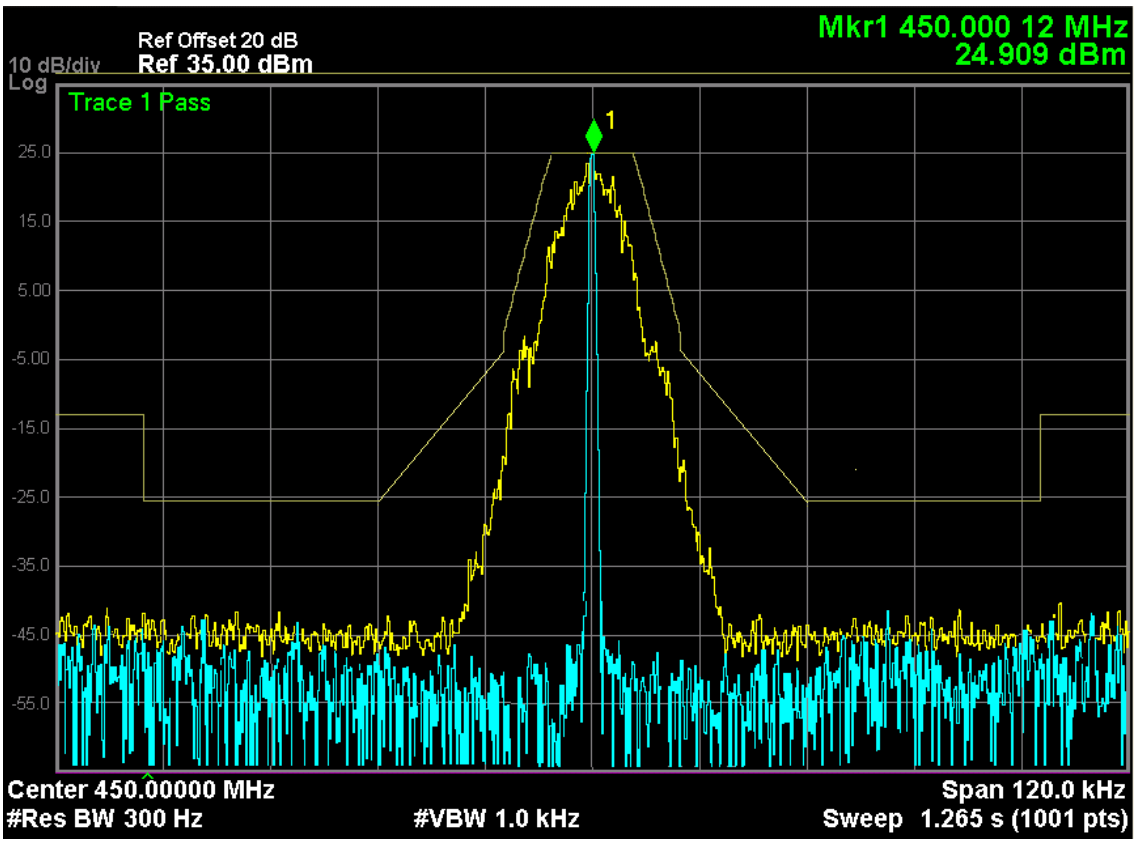

Ref Offset 20 dB
10 dB/div
Log
Ref 35.00 dBm
Mkr1 473.000 12 MHz
26.173 dBm
Trace 1 Pass
1
25.0
15.0
5.00
-5.00
-15.0
-25.0
-35.0
-45.0
-55.0
Center 473.00000 MHz
#Res BW 300 Hz
#VBW 1.0 kHz
Span 120.0 kHz
Sweep 1.265 s (1001 pts)

25 KHz Channel Separation, GMSK

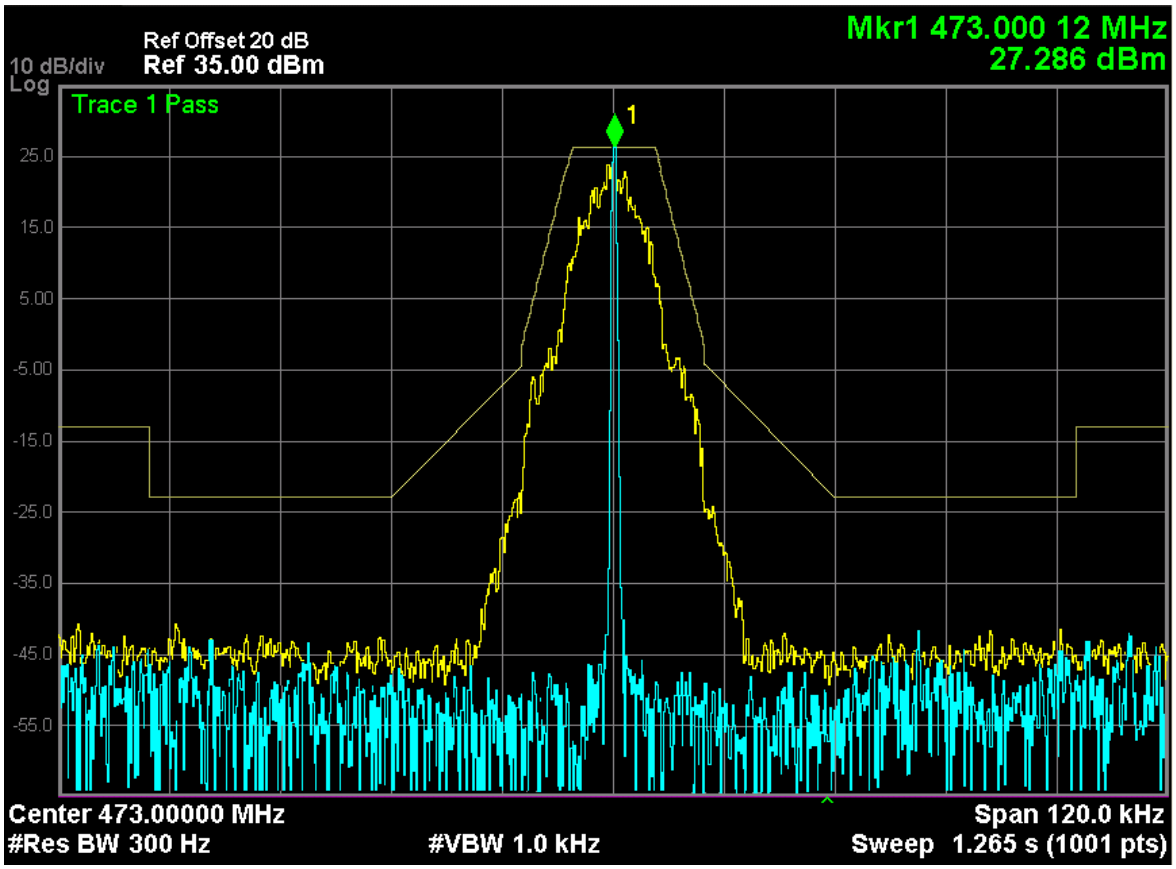
403MHz



450MHz

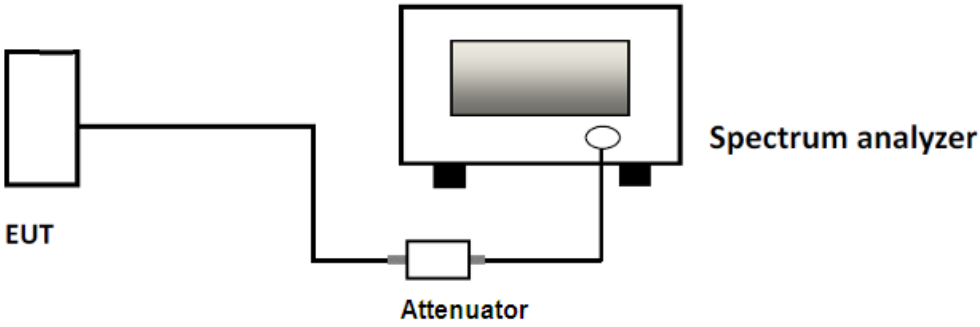


473MHz


Ref Offset 20 dB
10 dB/div
Log
Ref 35.00 dBm
Mkr1 473.000 12 MHz
27.286 dBm
Trace 1 Pass
1
25.0
15.0
5.00
-5.00
-15.0
-25.0
-35.0
-45.0
-55.0
Center 473.00000 MHz
#Res BW 300 Hz
#VBW 1.0 kHz
Span 120.0 kHz
Sweep 1.265 s (1001 pts)

8. OCCUPIED BANDWIDTH

8.1 TEST SETUP LAYOUT



8.2 TEST PROCEDURE

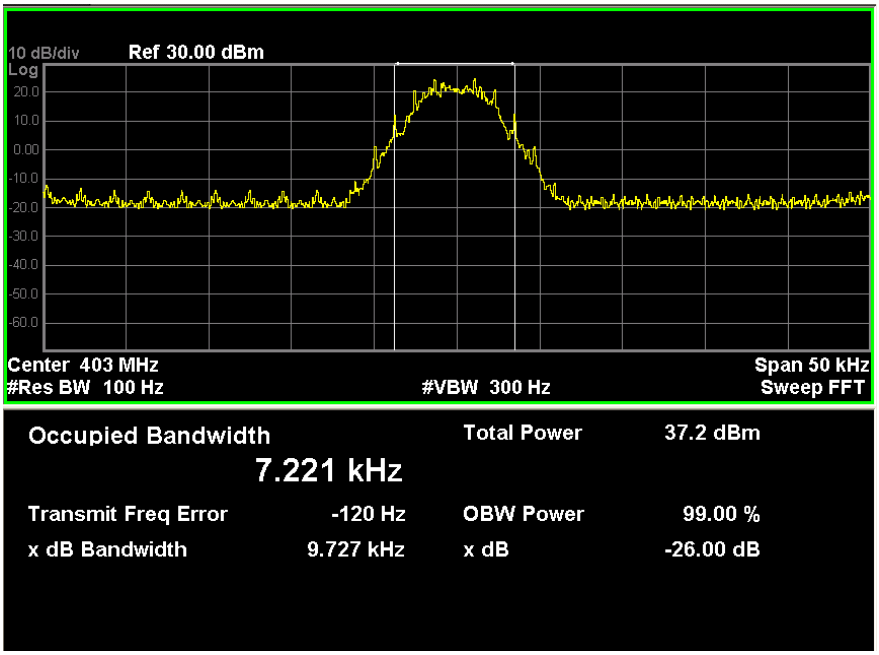
1. The transmitter output is connected to the spectrum analyzer through an attenuator.
2. Using Occupied Bandwidth measurement function of spectrum analyzer, and setting as those: Center Frequency=fundamental frequency, RBW=100Hz, VBW=300Hz and Span=50KHz.
3. According to FCC Part 90 Section 90.209, the authorized shall be 11.25KHz for 12.5KHz channel separation, and he authorized shall be 20KHz for 25KHz channel separation

8.3 TEST RESULTS

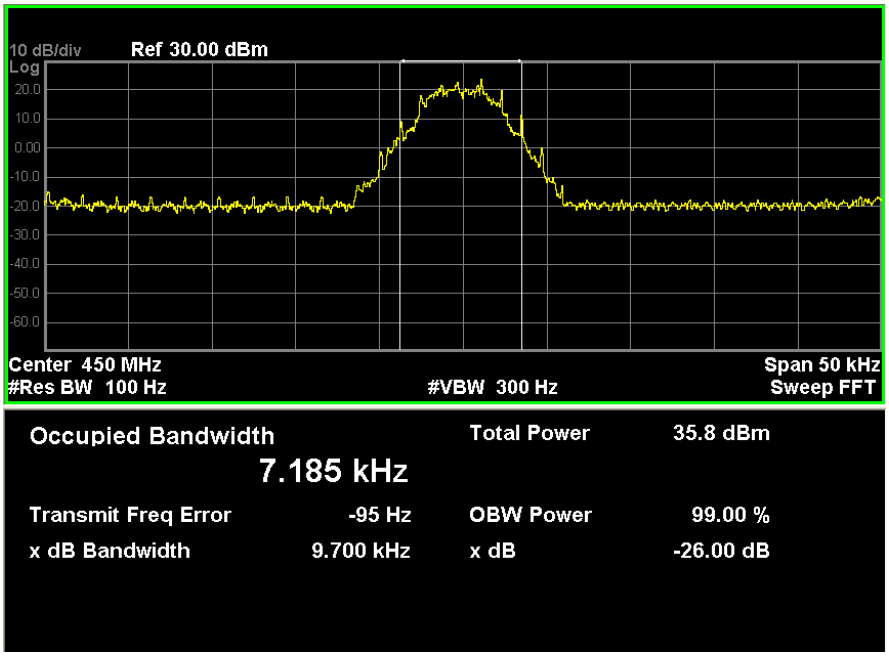
12.5 KHz Channel Separation, 4FSK

Frequency (MHz)	26dB Bandwidth (KHz)	99% Occupied Bandwidth (KHz)	Max. Limit (KHz)	Test Result
403	9.73	7.22	11.25	Pass
450	9.70	7.19	11.25	Pass
473	9.72	7.22	11.25	Pass

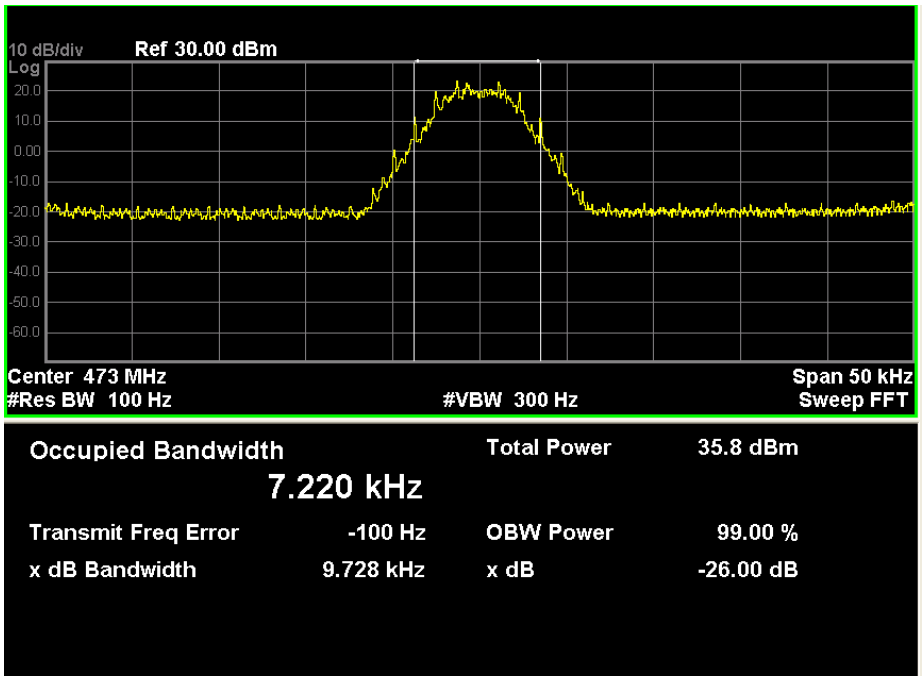
403MHz



450MHz



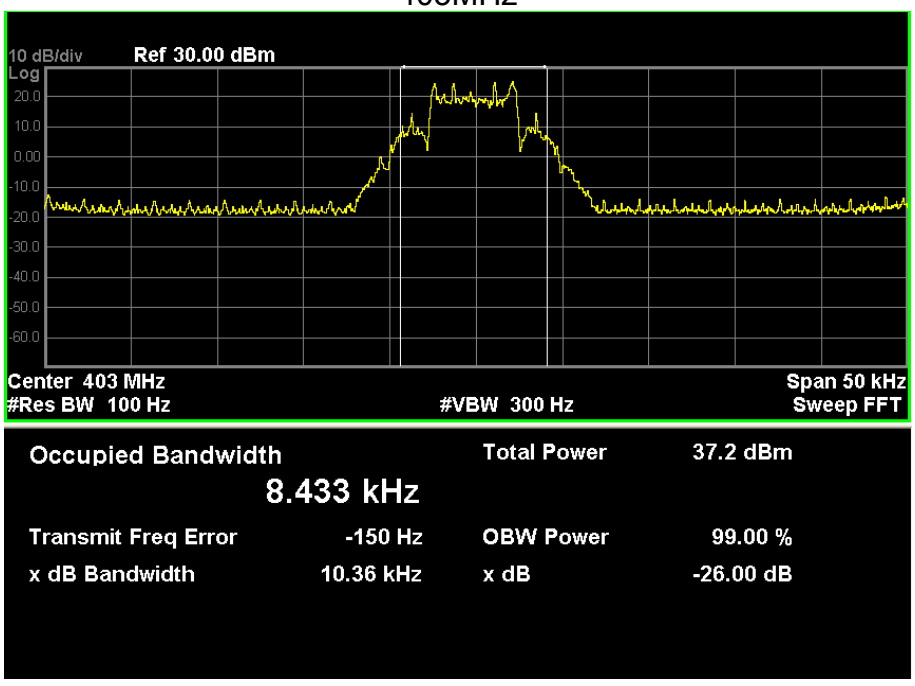
473MHz



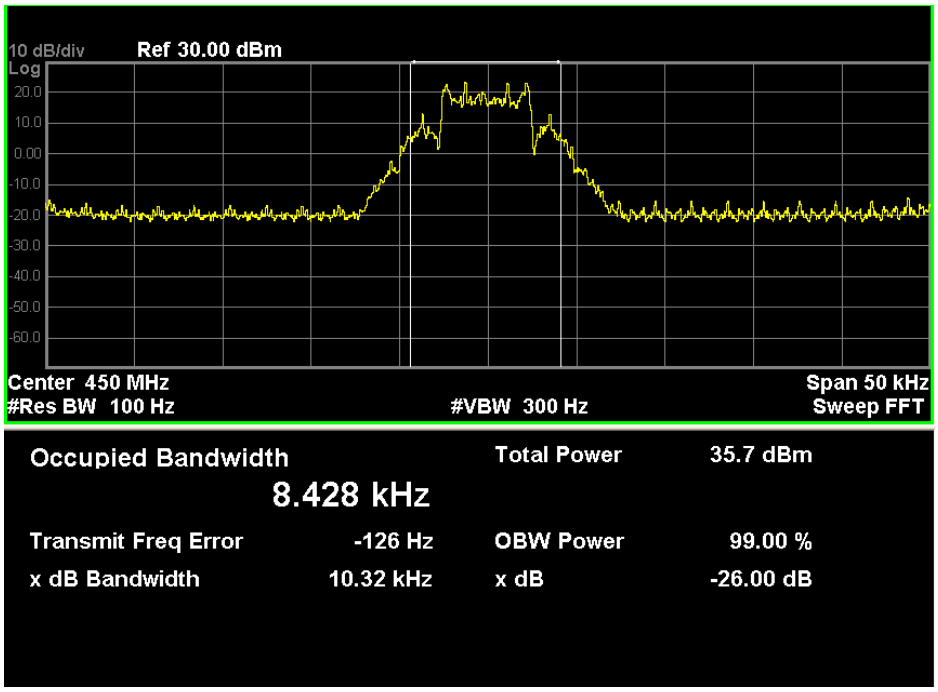
12.5 KHz Channel Separation, GMSK

Frequency (MHz)	26dB Bandwidth (KHz)	99% Occupied Bandwidth (KHz)	Max. Limit (KHz)	Test Result
403	10.36	8.43	11.25	Pass
450	10.32	8.43	11.25	Pass
473	10.04	8.45	11.25	Pass

403MHz

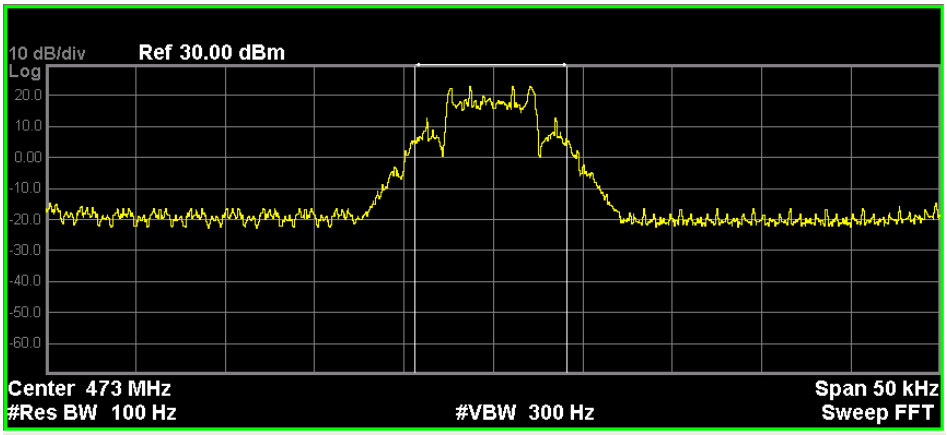


450MHz



Occupied Bandwidth		Total Power	35.7 dBm
8.428 kHz			
Transmit Freq Error	-126 Hz	OBW Power	99.00 %
x dB Bandwidth	10.32 kHz	x dB	-26.00 dB

473MHz

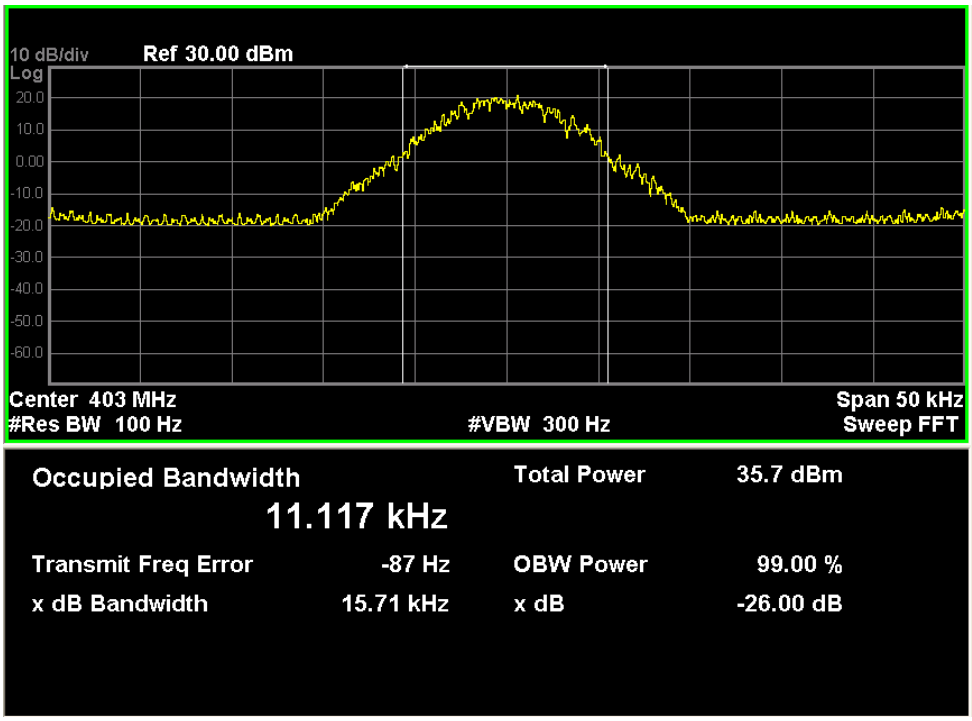


Occupied Bandwidth		Total Power	35.5 dBm
8.446 kHz			
Transmit Freq Error	-139 Hz	OBW Power	99.00 %
x dB Bandwidth	10.04 kHz	x dB	-26.00 dB

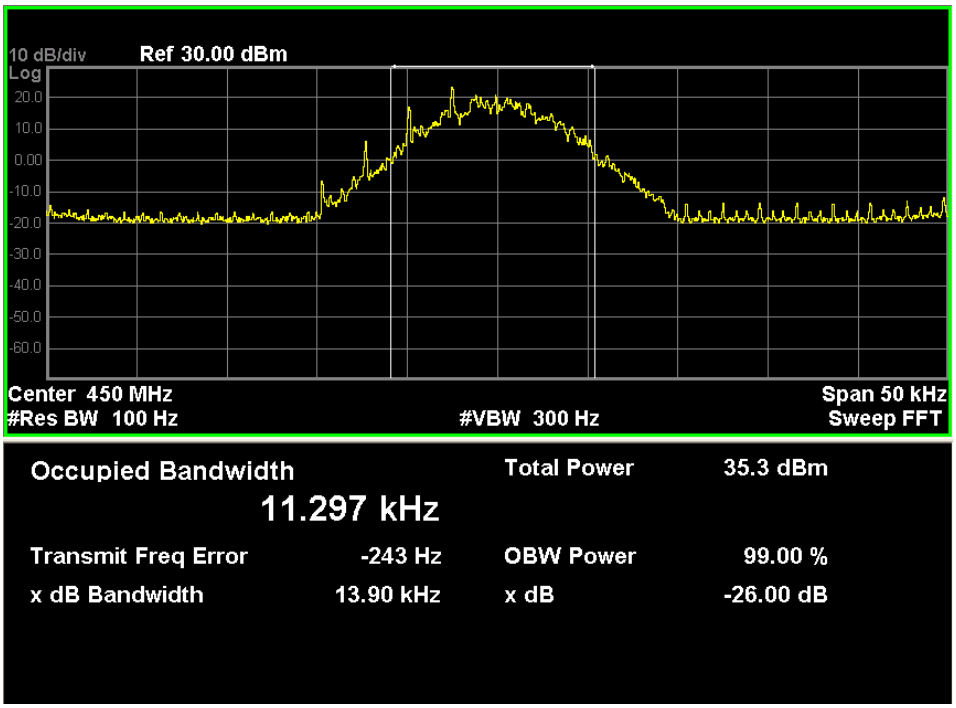
25 KHz Channel Separation, 4FSK

Frequency (MHz)	26dB Bandwidth (KHz)	99% Occupied Bandwidth (KHz)	Max. Limit (KHz)	Test Result
403	15.71	11.12	20	Pass
450	13.90	11.30	20	Pass
473	14.62	11.55	20	Pass

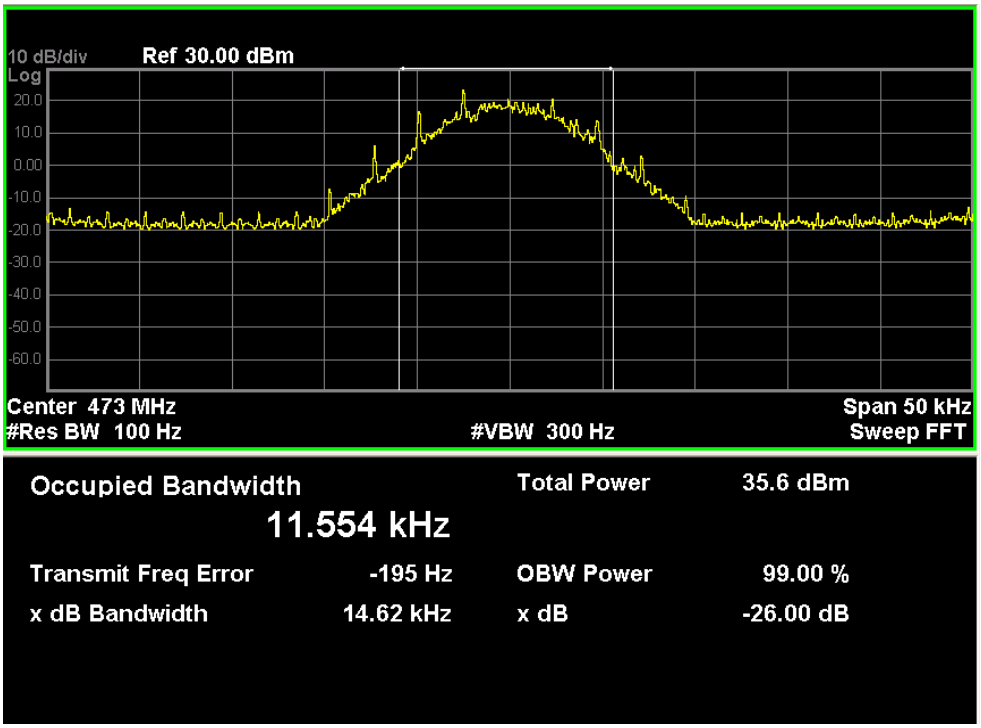
403MHz



450MHz



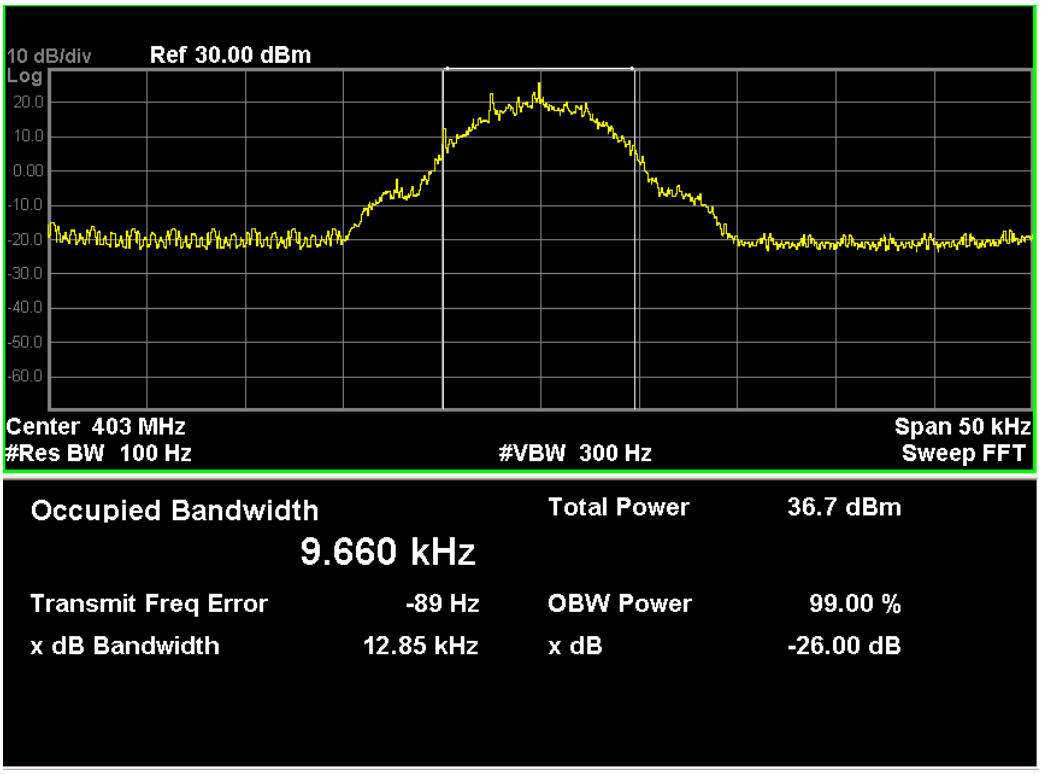
473MHz



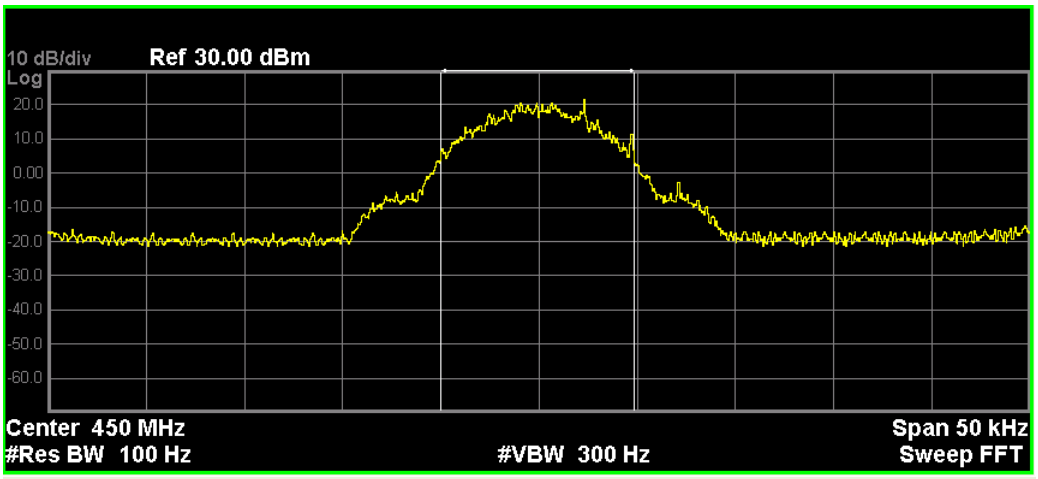
25 KHz Channel Separation, GMSK

Frequency (MHz)	26dB Bandwidth (KHz)	99% Occupied Bandwidth (KHz)	Max. Limit (KHz)	Test Result
403	12.85	9.66	20	Pass
450	13.04	9.75	20	Pass
473	13.02	9.68	20	Pass

403MHz

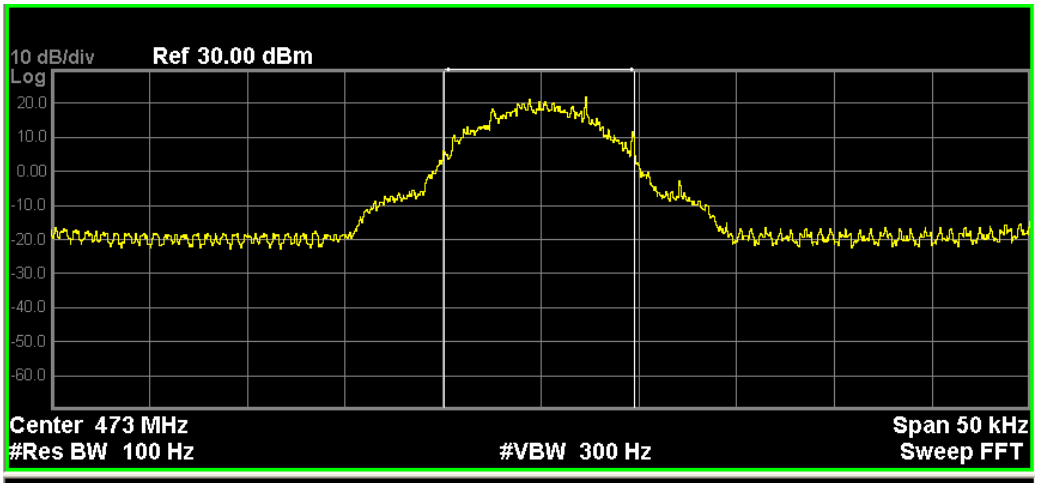


450MHz



Occupied Bandwidth		Total Power	35.5 dBm
9.748 kHz			
Transmit Freq Error	-73 Hz	OBW Power	99.00 %
x dB Bandwidth	13.04 kHz	x dB	-26.00 dB

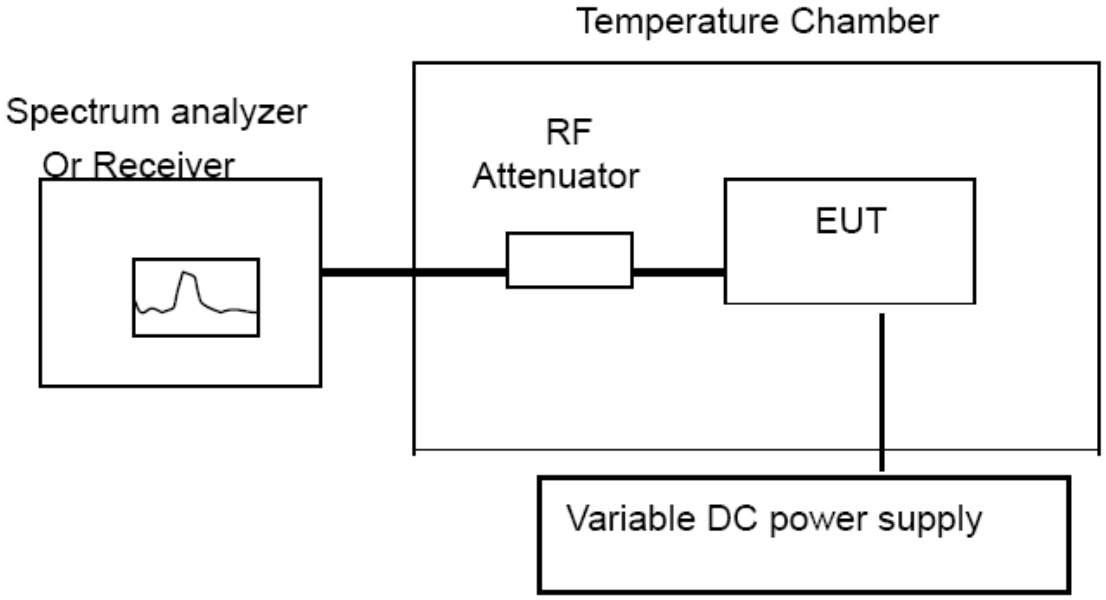
473MHz



Occupied Bandwidth		Total Power	35.6 dBm
9.680 kHz			
Transmit Freq Error	-82 Hz	OBW Power	99.00 %
x dB Bandwidth	13.02 kHz	x dB	-26.00 dB

9. FREQUENCY STABILITY

9.1 TEST SETUP LATOUT



9.2 TEST PROCEDURE

1. Setup the configuration per schematic diagram in section 9.1.
2. Set RBW of spectrum analyzer to 1KHz and VBW to 1KHz.
3. According to the part2.1055(a)(1),the EUT was evaluated over the temperature range -30℃ to +50℃
4. The temperature was initially set to -30℃ and a 1-hour period was observed for stabilization of the EUT. The frequency stability was measured within one minute after application of primary power to the transmitter. The temperature was raised at intervals of 10 degrees centigrade through the range. A 1/2-hour period was observed to stabilize the EUT at each measurement step and the frequency stability was measured within one minute after application of primary power to the transmitter. Additionally, according to the part2.1055(d)(1), the power supply voltage of the EUT was varied +/- 15% nominal input voltage.
5. Read the frequency of the carrier and calculate the deviation.

9.3 TEST RESULTS

12.5 KHz Channel Separation, 4FSK

Frequency Stability under Extreme Temperature

Test Frequency	403MHz	Limit	1.5ppm
Environment Temperature	Power Supply	Frequency Deviation	
(℃)	(V)	(MHz)	ppm
50	DC 12	403.000322	0.80
40	DC 12	403.000231	0.57
20	DC 12	403.000135	0.33
10	DC 12	403.000173	0.43
0	DC 12	403.000242	0.60
-10	DC 12	403.000233	0.58
-20	DC 12	403.000238	0.59
-30	DC 12	403.000253	0.63

Frequency Stability under Extreme Temperature

Test Frequency	450MHz	Limit	1.5ppm
Environment Temperature	Power Supply	Frequency Deviation	
(℃)	(V)	(MHz)	ppm
50	DC 12	450.000473	1.05
40	DC 12	450.000419	0.93
20	DC 12	450.000232	0.52
10	DC 12	450.000219	0.49
0	DC 12	450.000311	0.69
-10	DC 12	450.000323	0.72
-20	DC 12	450.000322	0.72
-30	DC 12	450.000338	0.75

Frequency Stability under Extreme Temperature

Test Frequency	473MHz	Limit	1.5ppm
Environment Temperature	Power Supply	Frequency Deviation	
(℃)	(V)	(MHz)	ppm
50	DC 12	473.000413	0.87
40	DC 12	473.000319	0.67
20	DC 12	473.000301	0.64
10	DC 12	450.000319	0.68
0	DC 12	473.000381	0.81
-10	DC 12	473.000373	0.79
-20	DC 12	473.000462	0.98
-30	DC 12	473.000398	0.84

Frequency Stability under Extreme Voltage

Test Frequency	403MHz	Limit	1.5ppm
Power Supply	Environment Temperature	Frequency Deviation	
(V)	(℃)	(MHz)	ppm
10.2	25	403.000242	0.60
12	25	403.000131	0.33
13.8	25	403.000335	0.83

Frequency Stability under Extreme Voltage

Test Frequency	450MHz	Limit	1.5ppm
Power Supply	Environment Temperature	Frequency Deviation	
(V)	(℃)	(MHz)	ppm
10.2	25	450.000253	0.56
12	25	450.000179	0.40
13.8	25	450.000332	0.74

Frequency Stability under Extreme Voltage

Test Frequency	473MHz	Limit	1.5ppm
Power Supply	Environment Temperature	Frequency Deviation	
(V)	(℃)	(MHz)	ppm
10.2	25	473.000374	0.79
12	25	473.000212	0.45
13.8	25	473.000338	0.71

12.5 KHz Channel Separation, GMSK

Frequency Stability under Extreme Temperature

Test Frequency	403MHz	Limit	1.5ppm
Environment Temperature	Power Supply	Frequency Deviation	
(℃)	(V)	(MHz)	ppm
50	DC 12	403.000342	0.85
40	DC 12	403.000230	0.57
20	DC 12	403.000178	0.44
10	DC 12	403.000203	0.50
0	DC 12	403.000242	0.60
-10	DC 12	403.000233	0.58
-20	DC 12	403.000318	0.79
-30	DC 12	403.000323	0.80

Frequency Stability under Extreme Temperature

Test Frequency	450MHz	Limit	1.5ppm
Environment Temperature	Power Supply	Frequency Deviation	
(℃)	(V)	(MHz)	ppm
50	DC 12	450.000383	0.85
40	DC 12	450.000359	0.80
20	DC 12	450.000203	0.45
10	DC 12	450.000219	0.49
0	DC 12	450.000311	0.69
-10	DC 12	450.000323	0.72
-20	DC 12	450.000299	0.66
-30	DC 12	450.000338	0.75

Frequency Stability under Extreme Temperature

Test Frequency	473MHz	Limit	1.5ppm
Environment Temperature	Power Supply	Frequency Deviation	
(℃)	(V)	(MHz)	ppm
50	DC 12	473.000372	0.79
40	DC 12	473.000319	0.67
20	DC 12	473.000232	0.49
10	DC 12	473.000219	0.46
0	DC 12	473.000311	0.66
-10	DC 12	473.000313	0.66
-20	DC 12	473.000332	0.70
-30	DC 12	473.000368	0.78

Frequency Stability under Extreme Voltage

Test Frequency	403MHz	Limit	1.5ppm
Power Supply	Environment Temperature	Frequency Deviation	
(V)	(℃)	(MHz)	ppm
10.2	25	403.000251	0.62
12	25	403.000234	0.58
13.8	25	403.000332	0.82

Frequency Stability under Extreme Voltage

Test Frequency	450MHz	Limit	1.5ppm
Power Supply	Environment Temperature	Frequency Deviation	
(V)	(℃)	(MHz)	ppm
10.2	25	450.000289	0.64
12	25	450.000235	0.52
13.8	25	450.000351	0.78

Frequency Stability under Extreme Voltage

Test Frequency	473MHz	Limit	1.5ppm
Power Supply	Environment Temperature	Frequency Deviation	
(V)	(℃)	(MHz)	ppm
10.2	25	473.000303	0.64
12	25	473.000249	0.53
13.8	25	473.000349	0.74

25 KHz Channel Separation, 4FSK

Frequency Stability under Extreme Temperature

Test Frequency	403MHz	Limit	1.5ppm
Environment Temperature	Power Supply	Frequency Deviation	
(℃)	(V)	(MHz)	ppm
50	DC 12	403.000402	1.00
40	DC 12	403.000331	0.82
20	DC 12	403.000215	0.53
10	DC 12	403.000273	0.67
0	DC 12	403.000242	0.60
-10	DC 12	403.000233	0.58
-20	DC 12	403.000298	0.74
-30	DC 12	403.000353	0.88

Frequency Stability under Extreme Temperature

Test Frequency	450MHz	Limit	1.5ppm
Environment Temperature	Power Supply	Frequency Deviation	
(℃)	(V)	(MHz)	ppm
50	DC 12	450.000393	0.87
40	DC 12	450.000349	0.78
20	DC 12	450.000212	0.47
10	DC 12	450.000229	0.51
0	DC 12	450.000241	0.54
-10	DC 12	450.000273	0.61
-20	DC 12	450.000292	0.65
-30	DC 12	450.000318	0.71

Frequency Stability under Extreme Temperature

Test Frequency	473MHz	Limit	1.5ppm
Environment Temperature	Power Supply	Frequency Deviation	
(℃)	(V)	(MHz)	ppm
50	DC 12	473.000411	0.87
40	DC 12	473.000379	0.80
20	DC 12	473.000213	0.45
10	DC 12	473.000239	0.51
0	DC 12	473.000271	0.57
-10	DC 12	473.000279	0.59
-20	DC 12	473.000312	0.66
-30	DC 12	473.000358	0.76

Frequency Stability under Extreme Voltage

Test Frequency	403MHz	Limit	1.5ppm
Power Supply	Environment Temperature	Frequency Deviation	
(V)	(℃)	(MHz)	ppm
10.2	25	403.000242	0.60
12	25	403.000192	0.48
13.8	25	403.000335	0.83

Frequency Stability under Extreme Voltage

Test Frequency	450MHz	Limit	1.5ppm
Power Supply	Environment Temperature	Frequency Deviation	
(V)	(℃)	(MHz)	ppm
10.2	25	450.000253	0.56
12	25	450.000209	0.46
13.8	25	450.000362	0.80

Frequency Stability under Extreme Voltage

Test Frequency	473MHz	Limit	1.5ppm
Power Supply	Environment Temperature	Frequency Deviation	
(V)	(℃)	(MHz)	ppm
10.2	25	473.000259	0.55
12	25	473.000217	0.46
13.8	25	473.000374	0.79

25 KHz Channel Separation, GMSK

Frequency Stability under Extreme Temperature

Test Frequency	403MHz	Limit	1.5ppm
Environment Temperature	Power Supply	Frequency Deviation	
(℃)	(V)	(MHz)	ppm
50	DC 12	403.000382	0.95
40	DC 12	403.000331	0.82
20	DC 12	403.000235	0.58
10	DC 12	403.000273	0.68
0	DC 12	403.000242	0.60
-10	DC 12	403.000258	0.64
-20	DC 12	403.000298	0.74
-30	DC 12	403.000316	0.78

Frequency Stability under Extreme Temperature

Test Frequency	450MHz	Limit	1.5ppm
Environment Temperature	Power Supply	Frequency Deviation	
(℃)	(V)	(MHz)	ppm
50	DC 12	450.000411	0.91
40	DC 12	450.000319	0.71
20	DC 12	450.000232	0.52
10	DC 12	450.000249	0.55
0	DC 12	450.000311	0.69
-10	DC 12	450.000293	0.65
-20	DC 12	450.000302	0.67
-30	DC 12	450.000312	0.69

Frequency Stability under Extreme Temperature

Test Frequency	473MHz	Limit	1.5ppm
Environment Temperature	Power Supply	Frequency Deviation	
(℃)	(V)	(MHz)	ppm
50	DC 12	473.000421	0.89
40	DC 12	473.000379	0.80
20	DC 12	473.000268	0.57
10	DC 12	473.000239	0.51
0	DC 12	473.000311	0.66
-10	DC 12	473.000323	0.68
-20	DC 12	473.000334	0.71
-30	DC 12	473.000328	0.69

Frequency Stability under Extreme Voltage

Test Frequency	403MHz	Limit	1.5ppm
Power Supply	Environment Temperature	Frequency Deviation	
(V)	(℃)	(MHz)	ppm
10.2	25	403.000214	0.53
12	25	403.000131	0.33
13.8	25	403.000335	0.83

Frequency Stability under Extreme Voltage

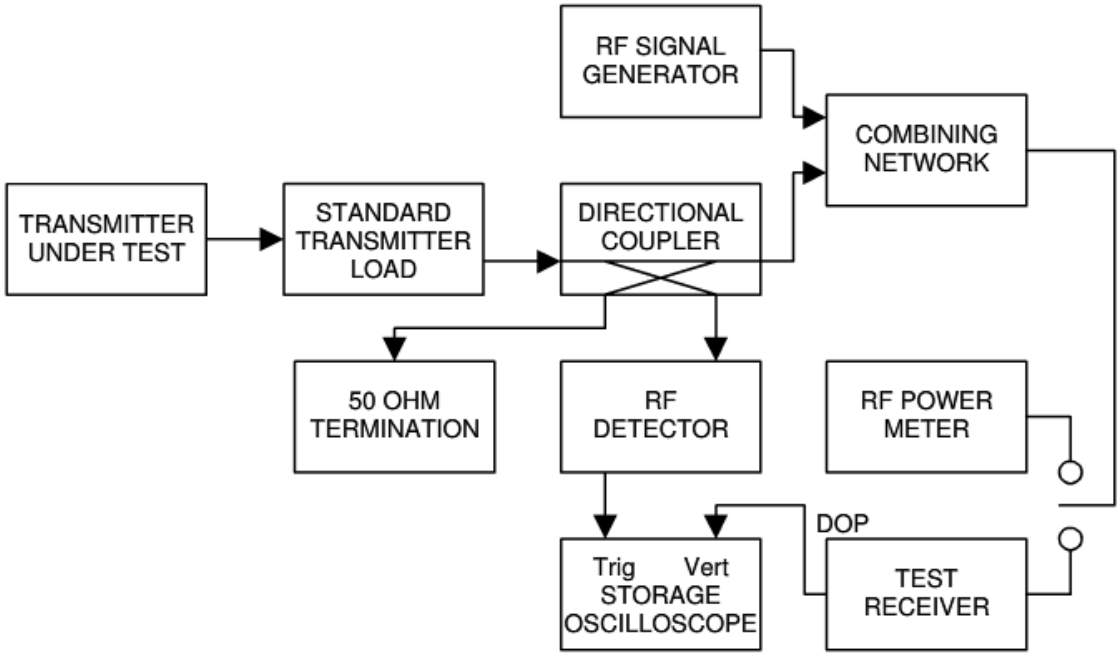
Test Frequency	450MHz	Limit	1.5ppm
Power Supply	Environment Temperature	Frequency Deviation	
(V)	(℃)	(MHz)	ppm
10.2	25	450.000221	0.49
12	25	450.000213	0.47
13.8	25	450.000334	0.74

Frequency Stability under Extreme Voltage

Test Frequency	473MHz	Limit	1.5ppm
Power Supply	Environment Temperature	Frequency Deviation	
(V)	(℃)	(MHz)	ppm
10.2	25	473.000303	0.64
12	25	473.000219	0.46
13.8	25	473.000387	0.82

10. TRANSIENT FREQUENCY BEHAVIOR OF TRANSMITTER

10.1 TEST SETUP LATOUT



10.2 TEST PROCEDURE

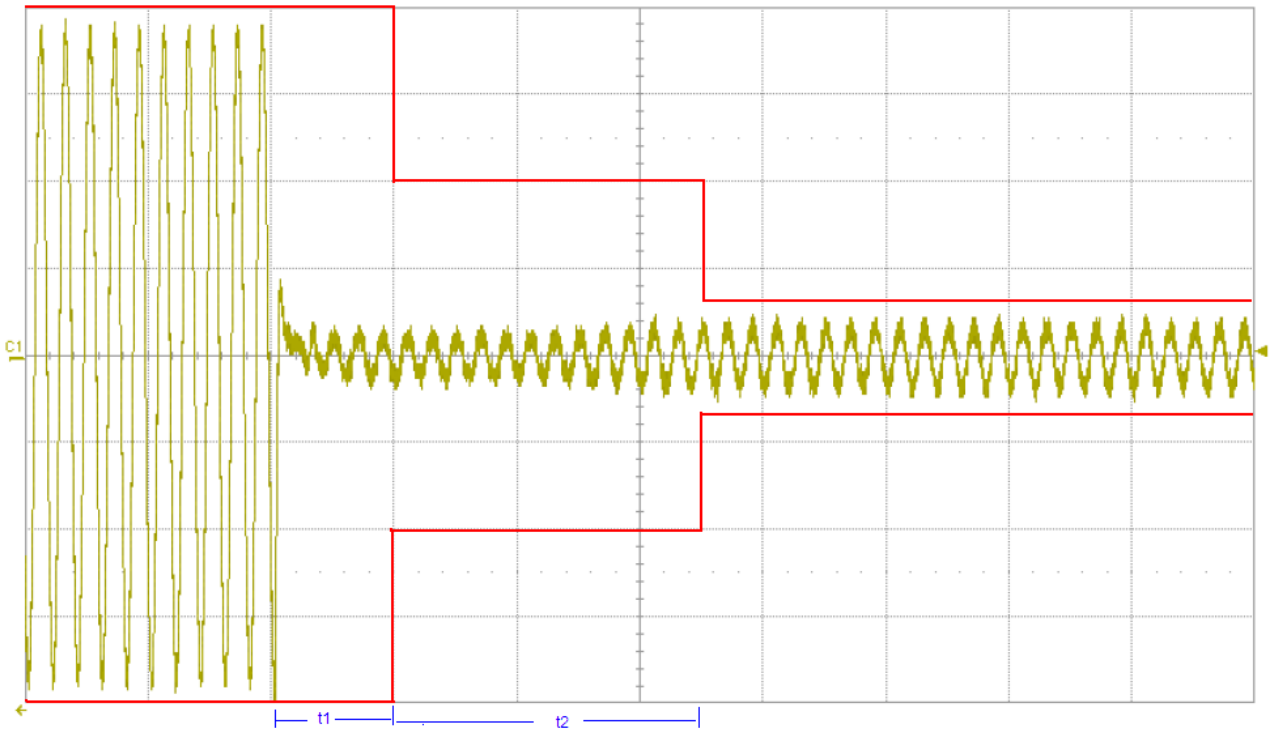
1. SG to the assigned transmitter frequency and modulate it with a 1KHz tone at ±25KHz deviation and set its output level to below 30dB of EUT signal level to receiver..
2. Set the horizontal sweep rate on the storage oscilloscope to 10ms per division and adjust the display to continuously view the 1000Hz tone from the DOP. Adjust the vertical amplitude control of the oscilloscope to display the 1000Hz at ±4 divisions vertically centered on the display.
3. Transmitter on and observe the stored display. The output at the DOP, due to the change in the ratio of power between the signal generator input power and the transmitter output power will, because of the capture effect of the test receiver, produce a change in display: For the first part of the sweep it will show the 1KHz test signal. Then once the receiver's demodulator has been captured by the transmitter power, the display will show the frequency difference from the assigned frequency to the actual transmitter frequency versus time. The instant when the 1KHz test signal is completely suppressed (including any capture time due to phasing) is considered to be $t_{on.}$ The trace should be maintained within the allowed divisions during the period t_1 and t_2. See the figure in the appropriated standards section.
4. . During the time from the end of t_2 to the beginning of t_3 the frequency difference should not exceed the limits set by the FCC in 47 CFR 90.214 and outline in 3.22. The allowed limit is equal to the transmitter frequency times its FCC frequency tolerance ±4 display divisions divided by 25KHz. For example, at the transmitter assigned frequency of 500MHz and a frequency tolerance of 5ppm. This would be 500MHz times 5ppm times ±4 divisions divided by 25KHz. This equals ±0.4 divisions in this example. Greater vertical sensitivity may be required to view this accurately.

5. Adjust the oscilloscope trigger controls so it will trigger on a decreasing magnitude from the RF peak detector, at 1 division from the right side of the display, when the transmitter is turned off. Set the controls to store the display. The moment when the 1KHz test signal starts to rise is considered to provide t_{off}.

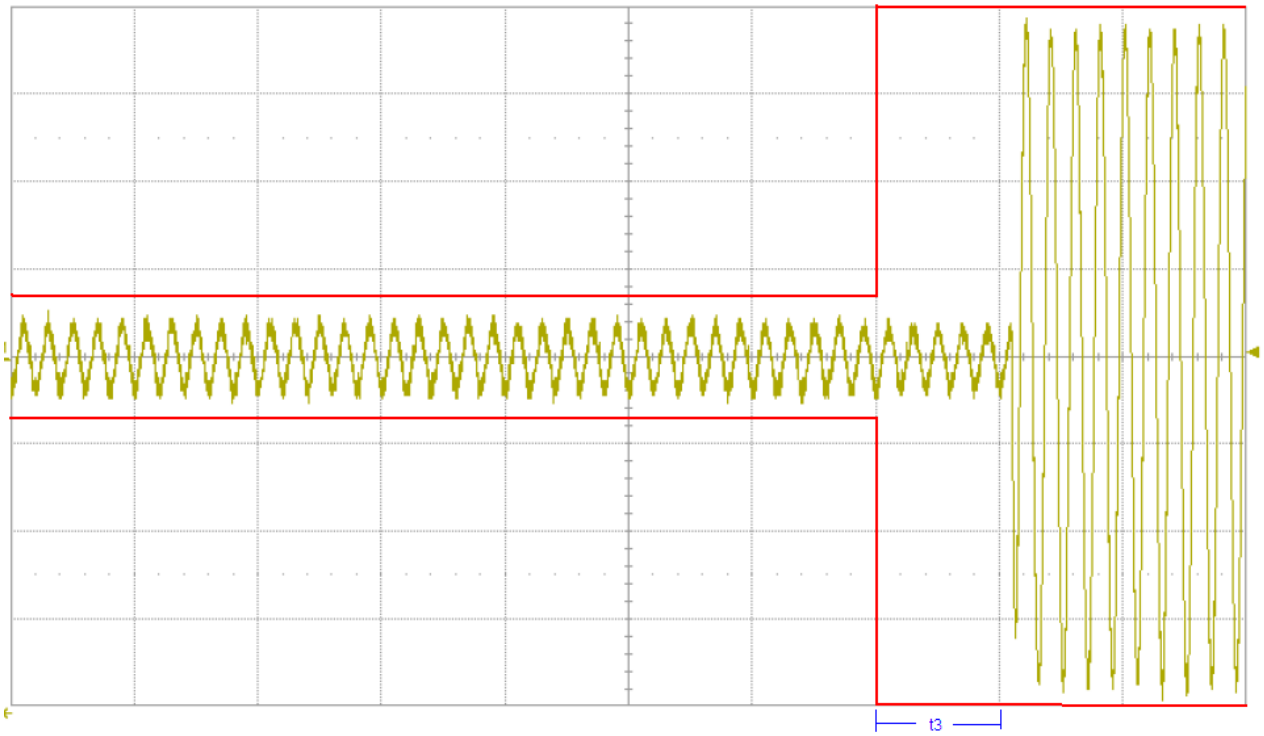
10.3 TEST RESULTS

12.5 KHz Channel Separation:

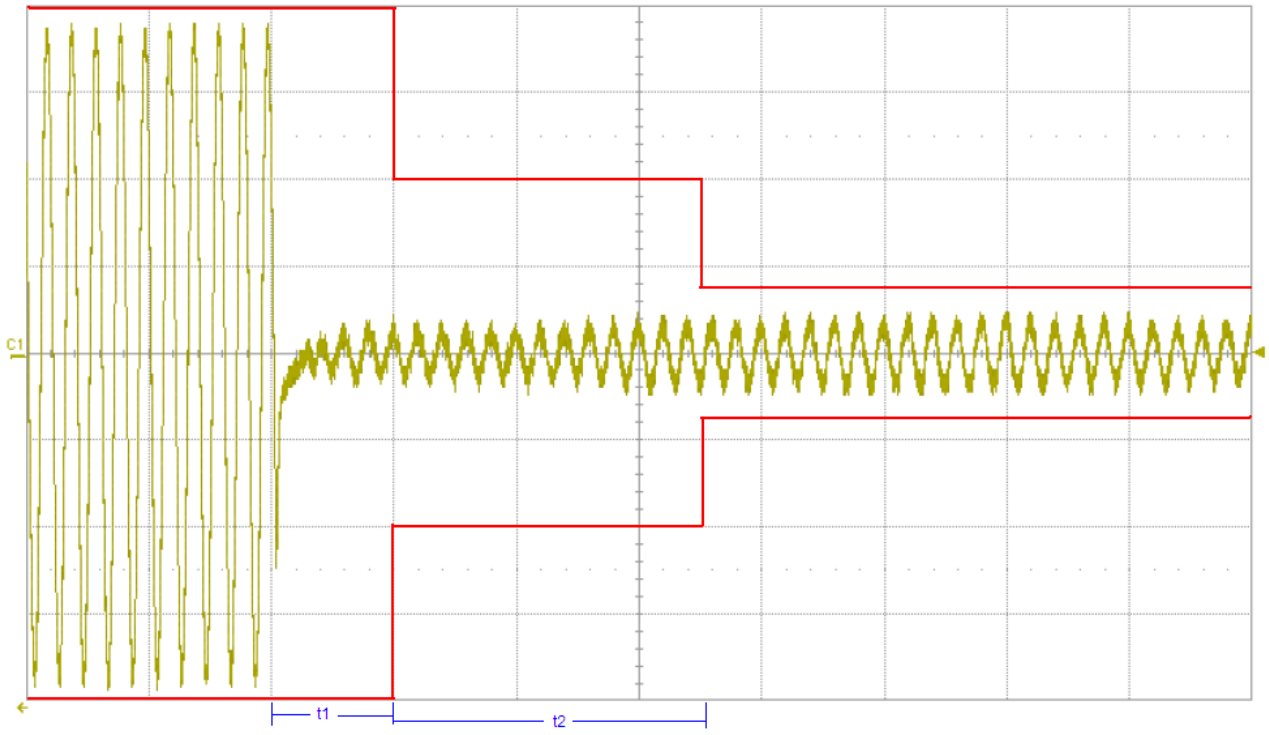
403MHz Off to On



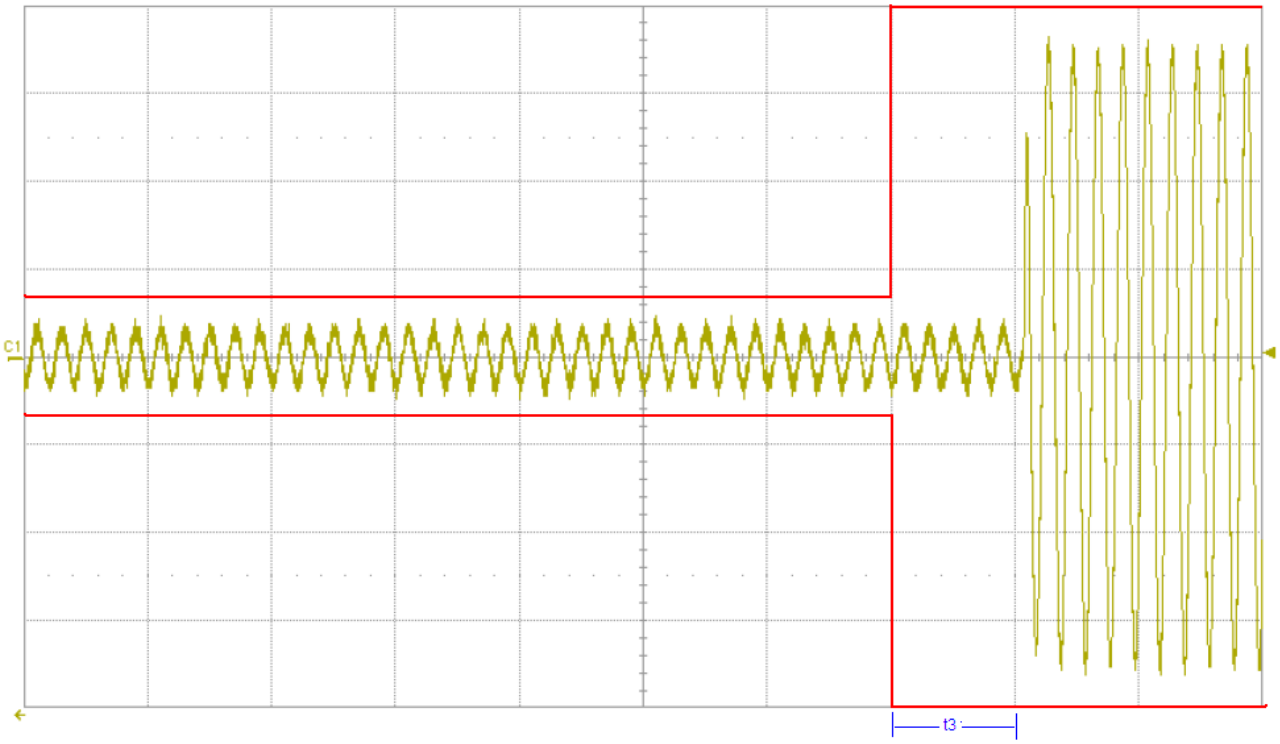
403MHz On to Off



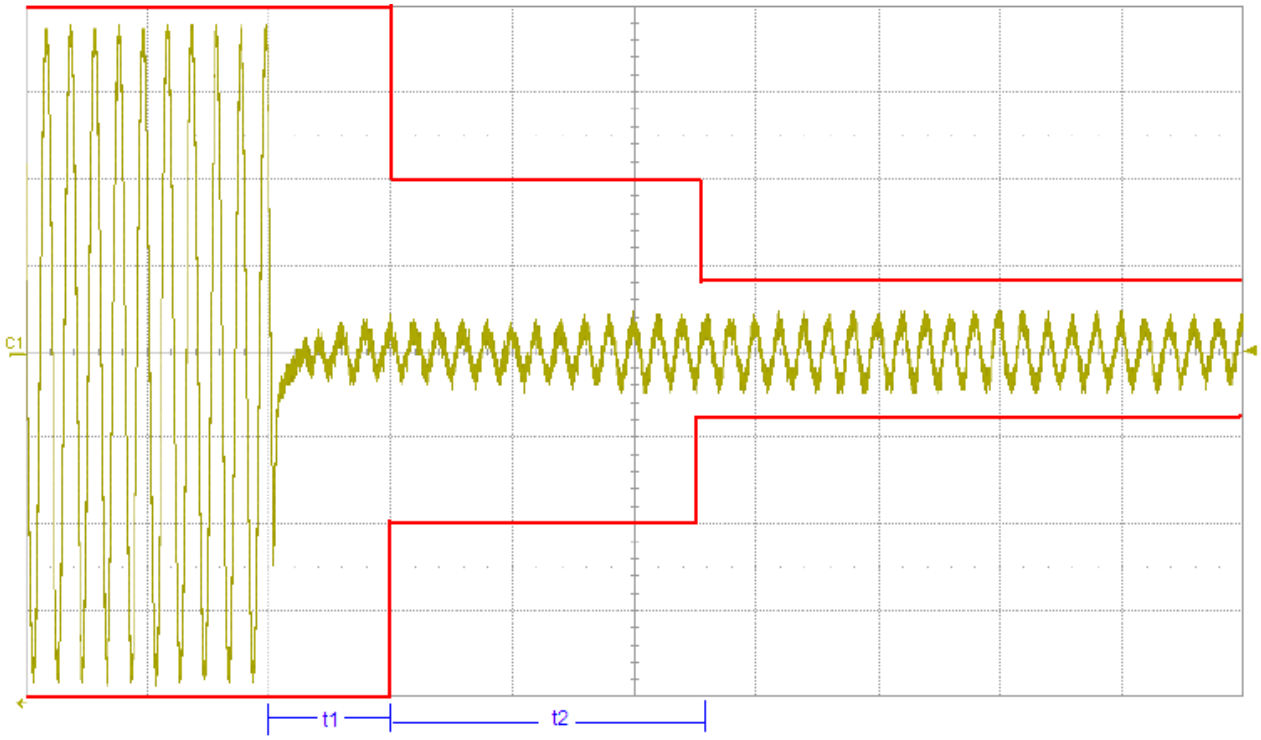
450MHz Off to On



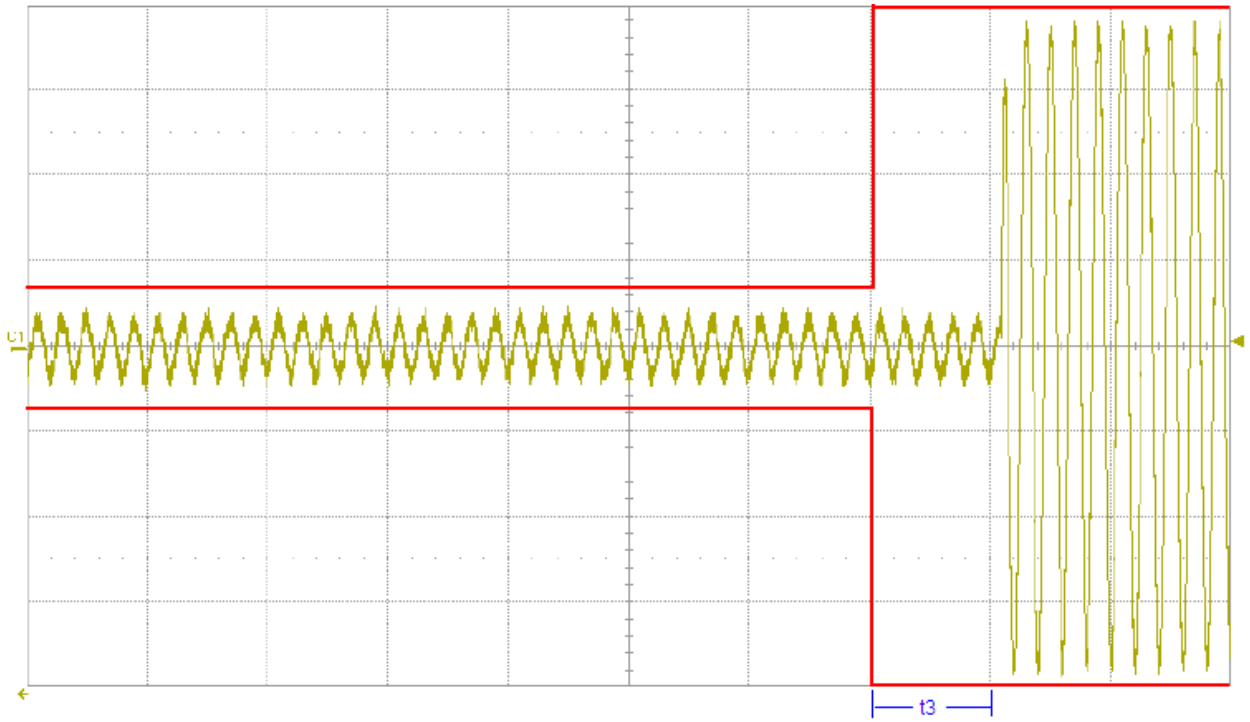
450MHz On to Off



473MHz Off to On

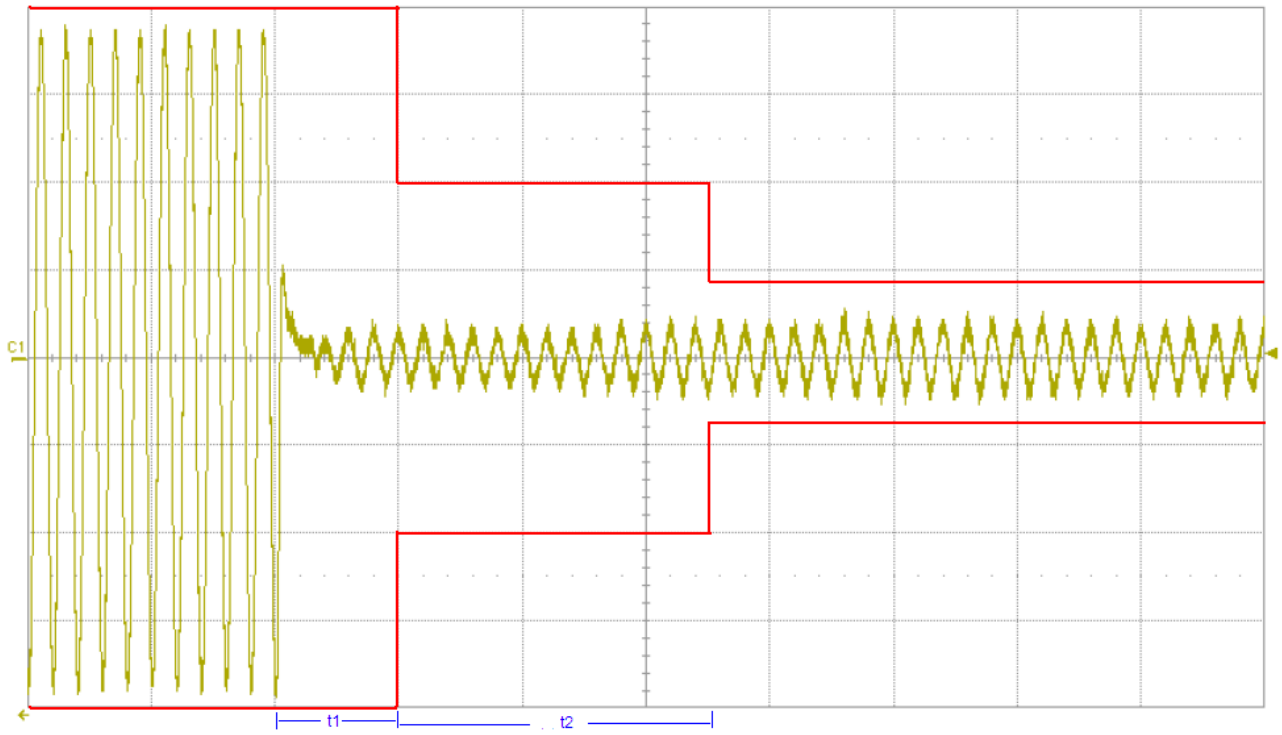


473MHz On to Off

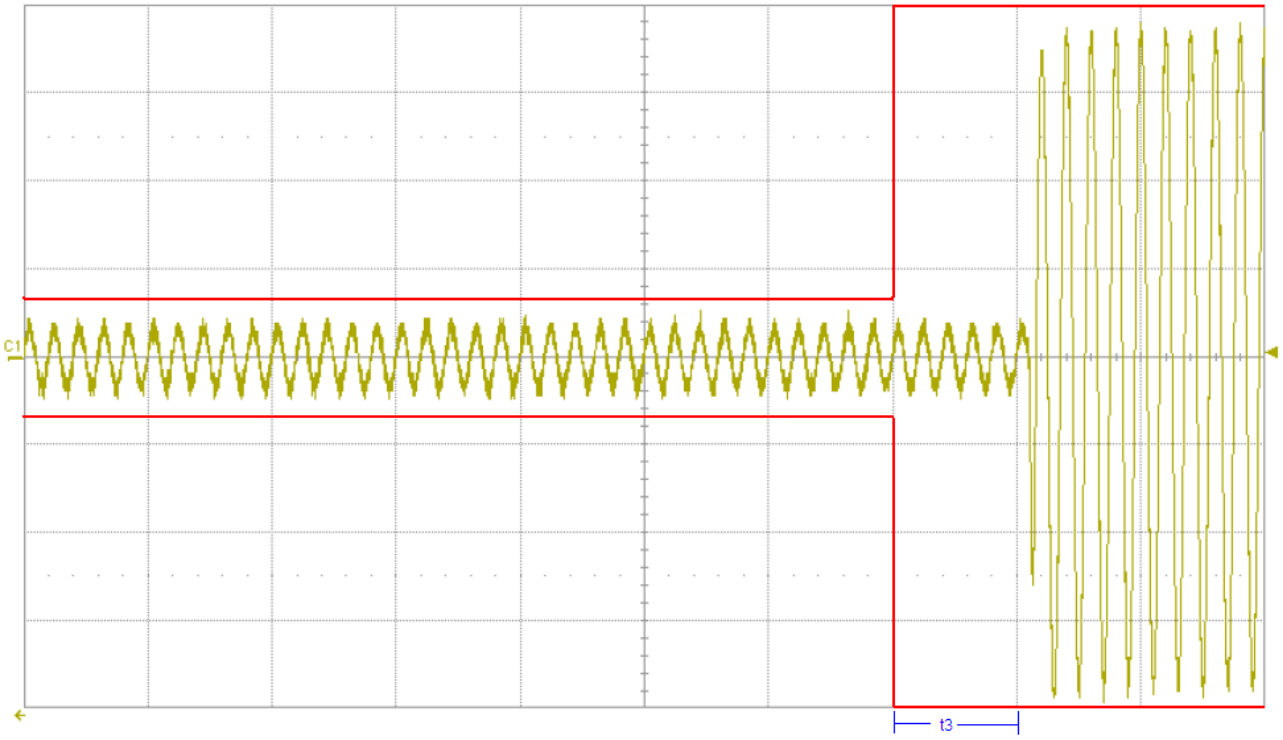


25 KHz Channel Separation:

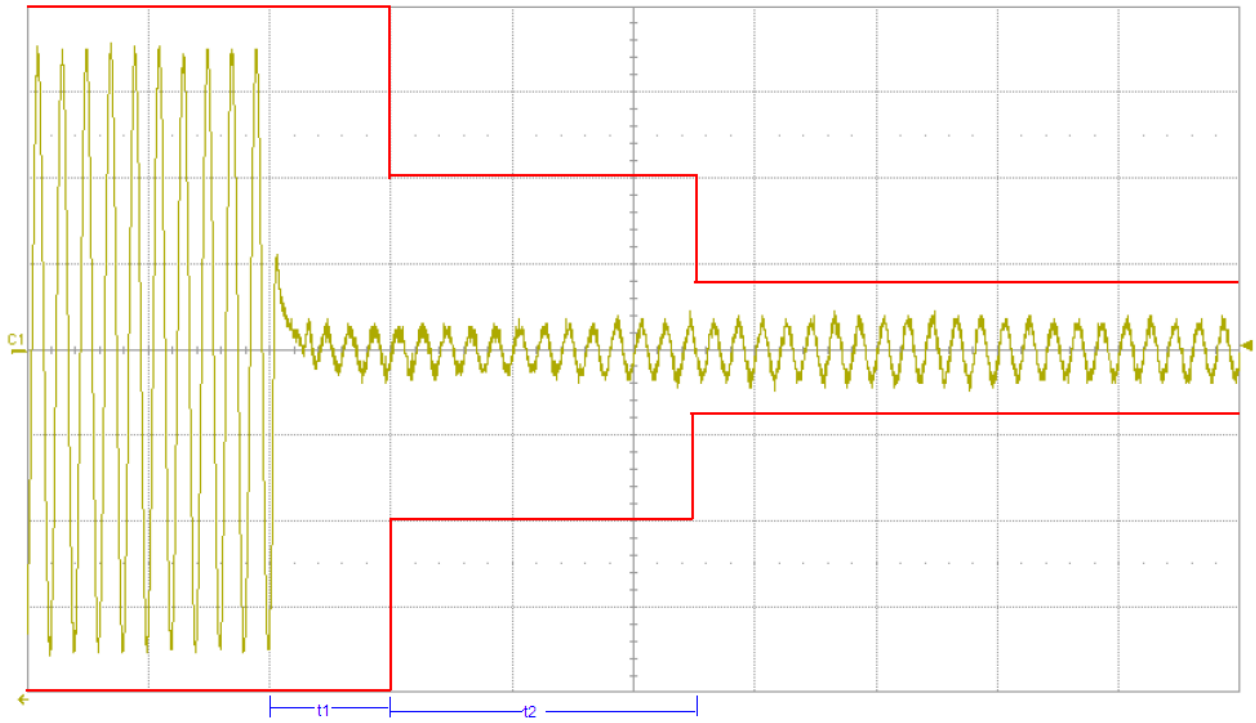
403MHz Off to On



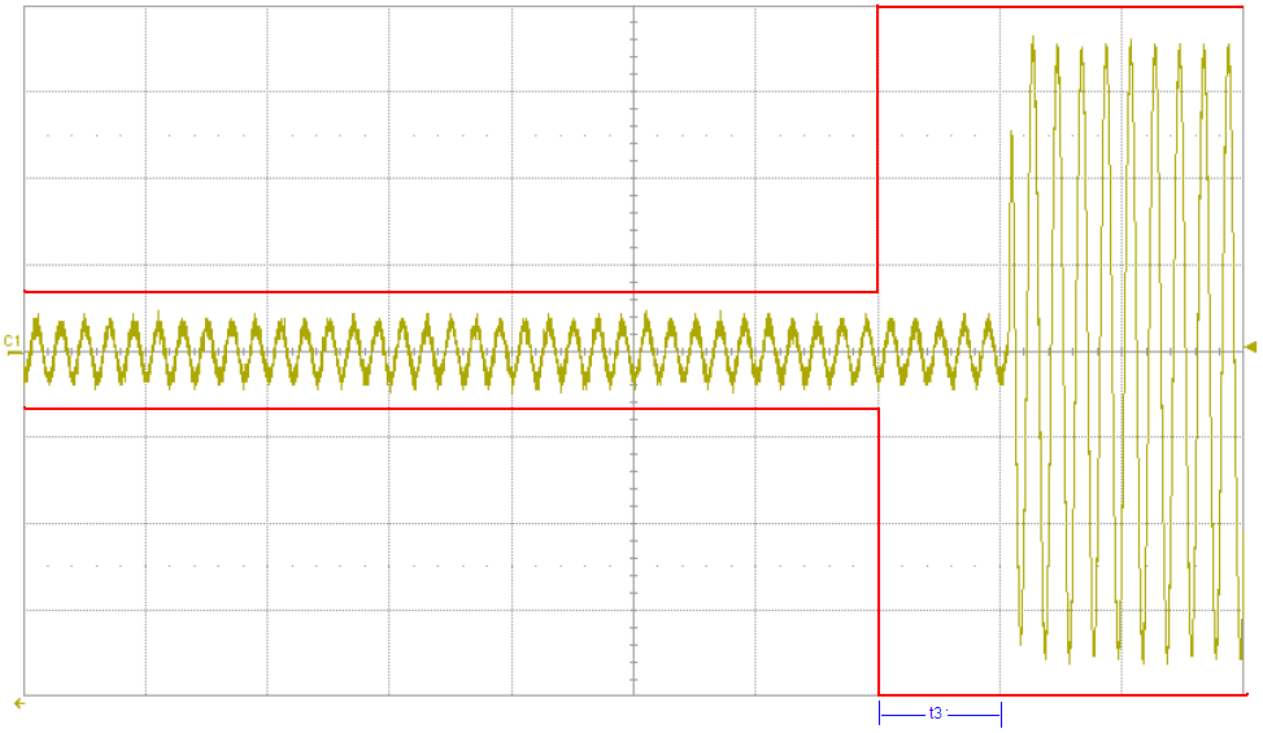
403MHz On to Off



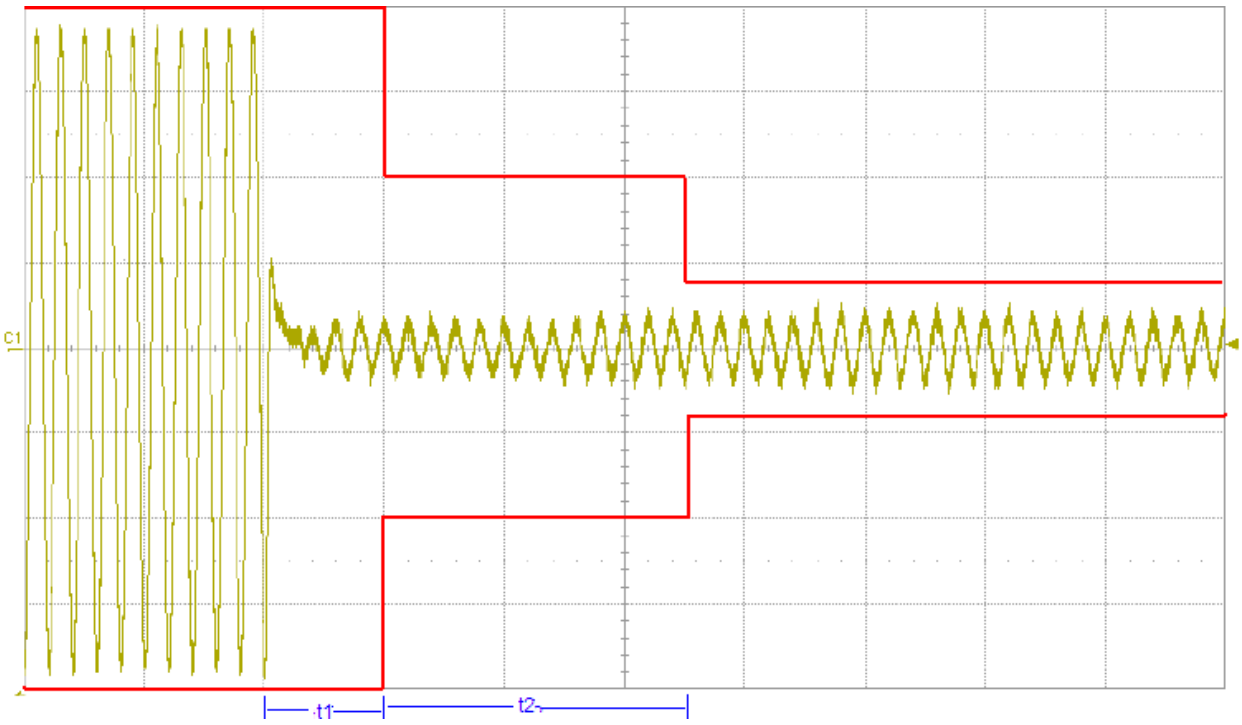
450MHz Off to On



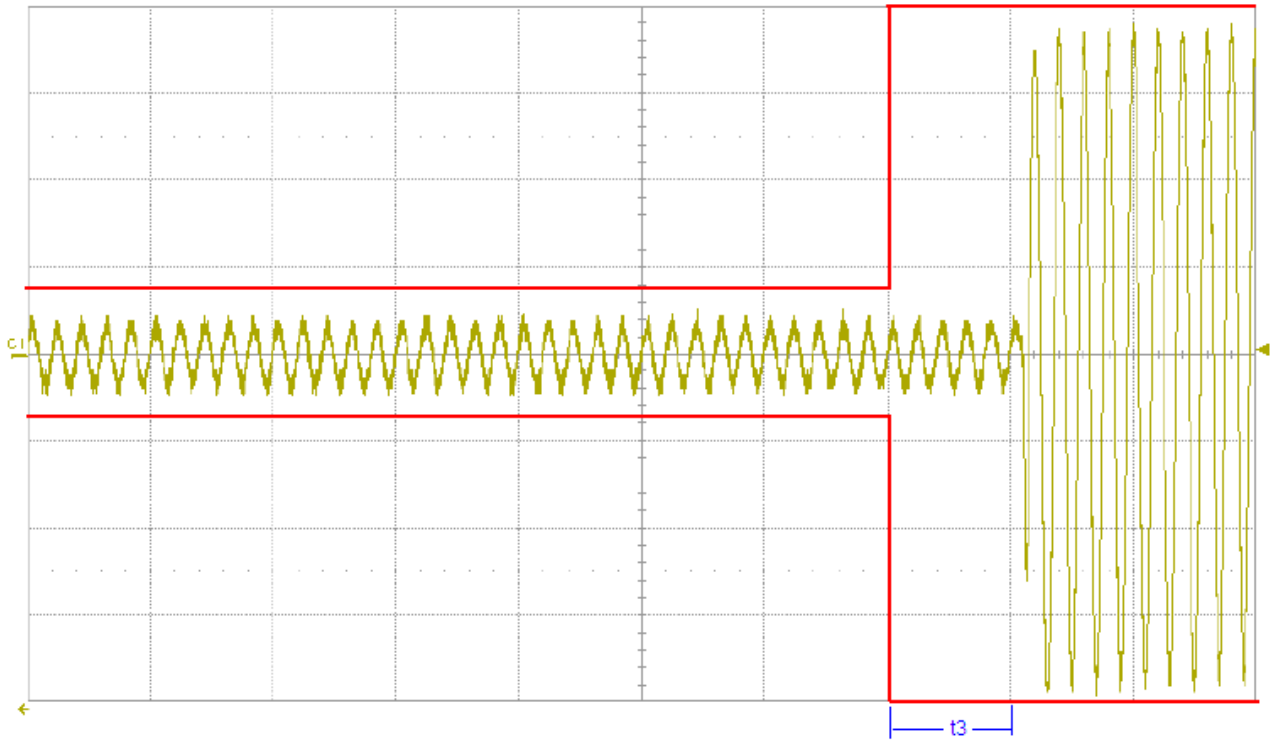
450MHz On to Off



473MHz Off to On



473MHz On to Off



APPENDIX 1 PHOTOGRAPHS OF TEST SETUP

Please refer to the file named “i80 WXYZ RF Setup Photos”.

APPENDIX 2 PHOTOGRAPHS OF EUT

Please refer to the files named “i80 WXYZ_EUT External Photos” and “i80 WXYZ_EUT Internal Photos”.

----End of the report----