



Test Report

Prepared for: Noxgear LLC

EUT Name: Wearable Bluetooth Speaker
Model: NG-WBS-01

FCC ID: 2A3FG-NOX01
IC: 27832-NOX01

To

FCC Part 15.247
And
ISED RSS-247

Date of Issue: 22 November 2021

On the behalf of the applicant:

Noxgear LLC
966 Proprietors Road
Worthington, OH 43085

Attention of:

Simon Curran, CEO
Ph: (614) 806-1477
Email: simon@noxgear.com

Prepared By
Compliance Testing, LLC
1724 S. Nevada Way
Mesa, AZ 85204
(480) 926-3100 phone / (480) 926-3598 fax
www.compliancetesting.com
Project No: p2170013

Aaron S. Froehlich
Sr RF/EMC Engineer

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All results contained herein relate only to the sample tested.

Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	22 November 2021	Aaron S. Froehlich	Original Document

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ANAB

Compliance Testing, LLC, has been accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to the joint ISO-ILAC-IAF Communiqué dated January 2009).

The tests results contained within this test report all fall within our scope of accreditation.

Please refer to <http://www.compliancetesting.com/labscope.html> for current scope of accreditation.



FCC Site Reg. #349717

IC Site Reg. #2044A-2

The applicant has been cautioned as to the following

15.21 - Information to User

The user's manual or instruction manual for an intentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

15.27(a) - Special Accessories

Equipment marked to a consumer must be capable of complying with the necessary regulations in the configuration in which the equipment is marketed. Where special accessories, such as shielded cables and/or special connectors are required to enable an unintentional or intentional radiator to comply with the emission limits in this part, the equipment must be marketed with, i.e. shipped and sold with, those special accessories. However, in lieu of shipping or packaging the special accessories with the unintentional or intentional radiator, the responsible party may employ other methods of ensuring that the special accessories are provided to the consumer without an additional charge.

Information detailing any alternative method used to supply the special accessories for a grant of equipment authorization or retained in the verification records, as appropriate. The party responsible for the equipment, as detailed in § 2.909 of this chapter, shall ensure that these special accessories are provided with the equipment. The instruction manual for such devices shall include appropriate instructions on the first page of text concerned with the installation of the device that these special accessories must be used with the device. It is the responsibility of the user to use the needed special accessories supplied with the equipment.

Standard Test Conditions Engineering Practices

Except as noted herein, the following conditions and procedures were observed during the testing:

In accordance with ANSI C63.10-2013 and unless otherwise indicated in the specific measurement results, the ambient temperature of the actual EUT was maintained within the range of 10° to 40°C (50° to 104°F) unless the particular equipment requirements specified testing over a different temperature range. Also, unless otherwise indicated, the humidity levels were in the range of 10% to 90% relative humidity.

Measurement results, unless otherwise noted, are worst-case measurements.

Environmental Conditions		
Temperature (°C)	Humidity (%)	Pressure (mbar)
22.0	35.4	973.4

EUT Description

Product Marketing Name (PMN)	Wearable Bluetooth Speaker
Hardware Version Identification Number (HVIN)	NG-WBS-01
Firmware Version Identification Number (FVIN)	1.0.0
Serial Number (SN)	01 (Radiated), 02 (Antenna Port Conducted)
AC Adapter	Model: A2620 Input: 100-240V, 0.5A, 50-60 Hz Output: 5V, 2.4A
Frequency Range	2402-2480 MHz
Number of Channels	79
Modulation(s)	GFSK, $\pi/4$ -DQPSK, 8DPSK
Data Rate(s)	1/2/3 Mbps Type: Chip
Antenna	Part Number: 2450AT18D0100E Pk Gain: 1.5 dBi Frequency Range: 2.4-2.5 GHz

General Description of EUT and its intended use:

The EUT is a wearable speaker that receives its audio information via BlueTooth v4.0. The inaccessible internal battery is charged from a standard Micro USB port.

EUT operation during test:

A normal production sample was tested for AC Conducted Emissions, while hopping. A test mode sample with chip antenna attached was used for the Radiated Spurious Emissions demonstration. An antenna port conducted sample that has had the chip antenna replaced with a u.fl connector was tested for all other requirements.

Test mode samples were operated via Qualcomm BlueSuite 2.6.11 BlueTest3 application. A SPI to USB interface board was used with a support laptop. The commands utilized and their associated parameters are:

CFG PKT

Test Arguments:

- Packet Type – Values between 3 and 31 corresponding to the data rate desired for test.
- Packet Size – Always set to the maximum value allowable for that packet type.

TXDATA1 – Commands the DUT to transmit on a single frequency with PRBS9 data.

Test Arguments:

- LO Freq: The frequency under test. Values used were 2402, 2441, 2480
- Power (Ext, Int)
 - Ext – External amplification always set to a maximum value of 255
 - Int – Internal amplification, maximum value of 63 for Basic Data Rates, maximum value of 127 for Enhanced data rates

TXDATA2 – Commands the DUT to transmit with hopping active and PRBS9 data..

Test Arguments:

- Country Code [obsolete command] = always 0
- Power (Ext, Int)
 - Ext – External amplification always set to a maximum value of 255
 - Int – Internal amplification, maximum value of 63 for Basic Data Rates, maximum value of 127 for Enhanced data rates

Modes of Operation Tested:

Data Rate [Name]	Data Rate [Mbps]	Modulation	CFG PKT [Packet Type]	CFG PKT [Packet Size]
BDR DM1	1	GFSK	3	17
BDR DM3	1	GFSK	10	121
BDR DH3	1	GFSK	11	183
BDR DM5	1	GFSK	14	224
BDR DH5	1	GFSK	15	339
EDR DM1	2	$\pi/4$ -DQPSK	19	17
EDR 2-DH3	2	$\pi/4$ -DQPSK	26	367
EDR 3-DH3	3	8DPSK	27	552
EDR 2-DH5	2	$\pi/4$ -DQPSK	30	679
EDR 3-DH5	3	8DPSK	31	1021

BDR = Basic Data Rate

EDR = Enhanced Data Rate

DM# vs DH# - there is no difference in the physical transmission between DM and DH data rates. This is a payload configuration where DM packets have some packet size dedicated for Forward Error Correction. It was further verified that there is no significant difference between these test modes via Duty Cycle, Dwell Time, Bandwidth, and Output Power tests.

Accessories:

Qty	Description	Manufacturer	Model	S/N
1	Power Port Adapter	Anker	A2620	AEDPC50B09206235
1	MP3 Player mini	Shenzhenshi	M3	001

Cables:

Qty	Description	Length (M)	Shielding Y/N	Shielded Hood Y/N	Termination
1	Charging cable	0.91	Y	Y	Power Power Adapter

Modifications:

none

15.203: Antenna Requirement:

- ☒ The antenna is permanently attached to the EUT
- ☐ The antenna uses a unique coupling
- ☐ The EUT must be professionally installed
- ☐ The antenna requirement does not apply

Test Summary

FCC 15.247 Specification	RSS-247 Specification	Test Name	Pass, Fail, N/A	Comments
15.247(b)(1)	Section 5.4(b)	Output Power	Pass	
15.247(d)	Section 5.5	Conducted Spurious Emissions	Pass	
15.247(d), 15.209(a), 15.205	Section 5.5	Radiated Spurious Emissions	Pass	
15.247(d), 15.209(a), 15.205	Section 5.5	Emissions At Band Edges	Pass	
15.247(a)(1)	Sections 5.1(a)	Occupied Bandwidth	Pass	RSS-Gen Section 6.7 99% BW Also Reported
15.247(a)	Section 5.1 (c)	Dwell Time	Pass	
15.247(a)	Section 5.1 (d)	Number of Hopping Channels	Pass	
15.247(a)	Section 5.1 (b)	Channel Separation	Pass	
15.207	RSS-GEN Section 8.8	A/C Powerline Conducted Emissions	Pass	

Statements of conformity are reported as:

- Pass - the measured value is below the acceptance limit, *acceptance limit = test limit*.
- Fail - the measured value is above the acceptance limit, *acceptance limit = test limit*.

References	Description
CFR47, Part 15, Subpart B	Unintentional Radiators
CFR47, Part 15, Subpart C	Intentional Radiators
ANSI C63.10-2013	American National standard for testing Unlicensed Wireless Devices
ANSI C63.4-2014	Method and Measurements of Radio-Noise Emissions from low-Voltage Electrical and Electronic Equipment in the range 9kHz to 40GHz.
ISO/IEC 17025:2005	General requirements for the Competence of Testing and Calibrations Laboratories
KDB 558074 D01 v04	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating under §15.247

Occupied Bandwidth

Engineer: Aaron S. Froehlich

Test Date: 11/08/21

Test Procedure

The method of ANSI C63.10 Clause 7.8.7, which references Clause 6.9.2 were utilized to measure the 20 dB Occupied Bandwidth. The “n dB down” function of the spectrum analyzer, with $n = 20$, was used as long as the marker did not settle in a null region. When that was the case the markers were manually configured from the edge of the emission until a value equal to or less than n dB below the peak was used.

The method of clause 6.9.3 was utilized to measure the 99% Occupied Bandwidth.

Limit 20 dB

None – Other limits are calculated from the 20 dB Occupied Bandwidth.

Limit 99%

RSS-Gen Section 6.7 requires the 99% Occupied Bandwidth be reported in addition to all other required bandwidths.

The Spectrum Analyzer was set to the following:

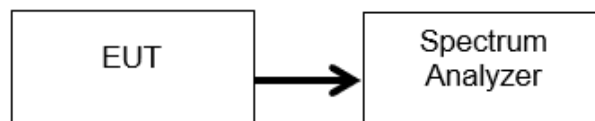
20 dB Occupied Bandwidth

Span	Between two times and five times the OBW
RBW	1% to 5% of the OBW
VBW	~3 time RBW

99% Occupied Bandwidth

Span	Between 1.5 times and 5.0 times the OBW
RBW	1% to 5% of the OBW
VBW	~3 time RBW

Test Setup

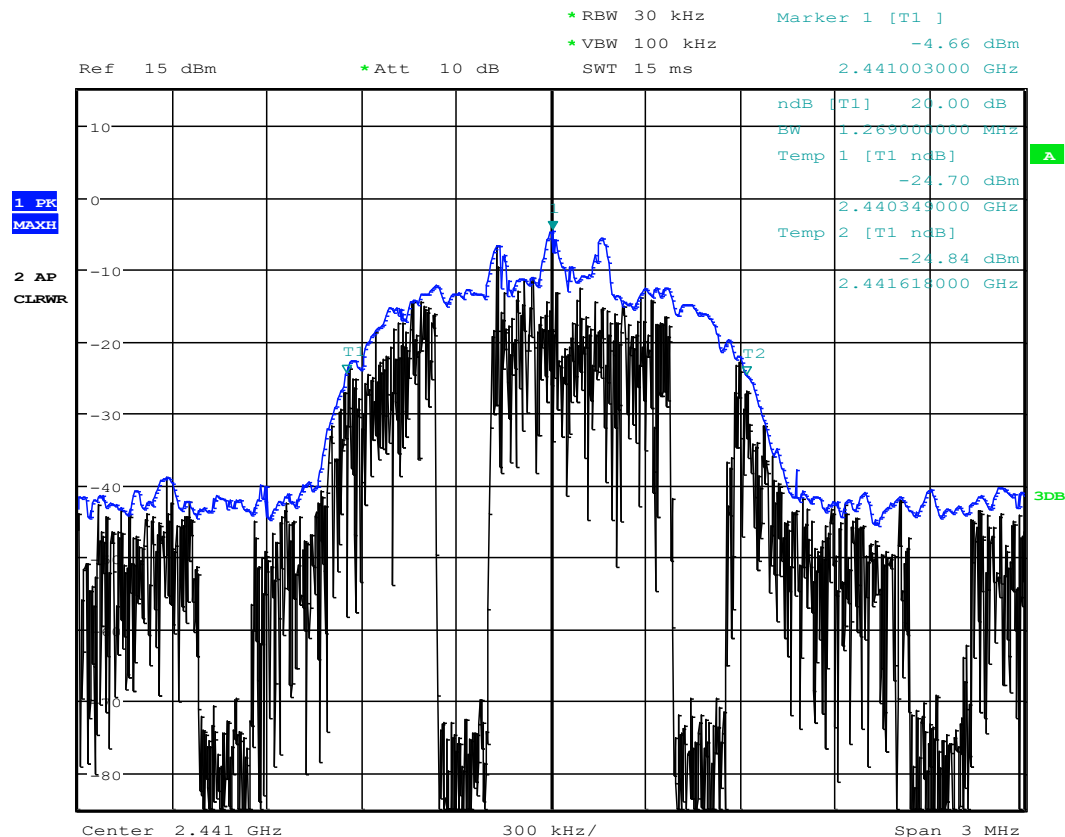
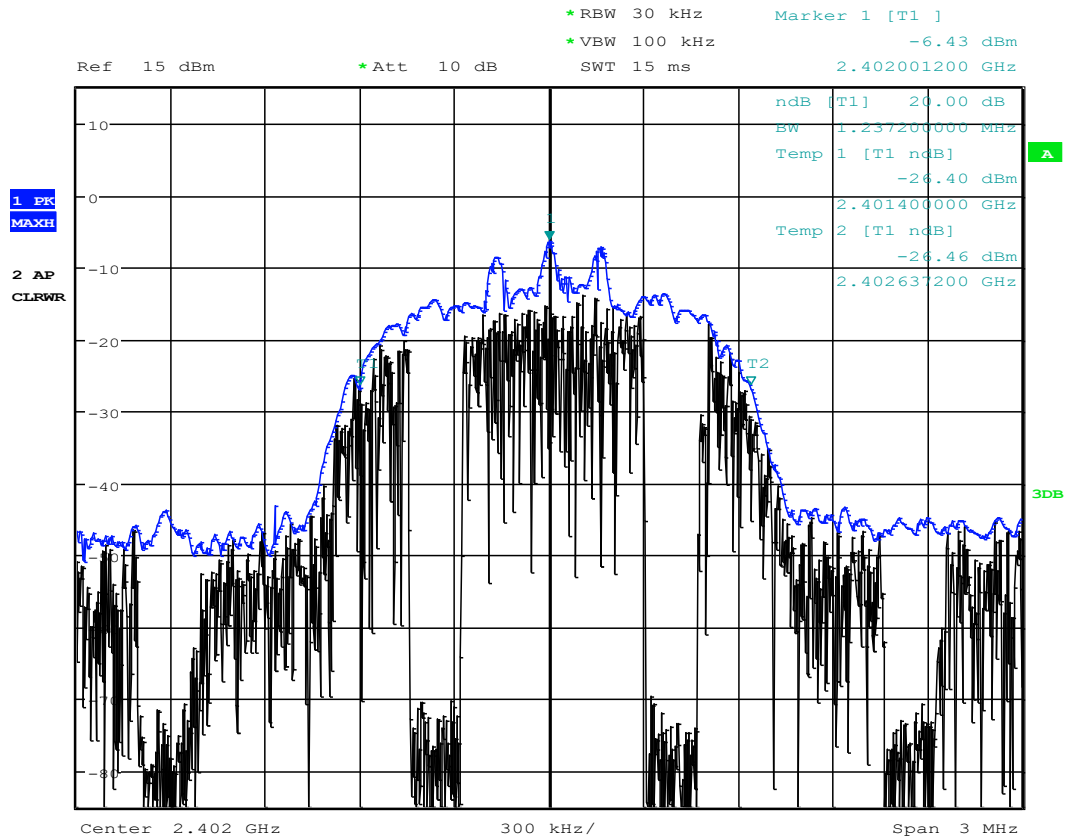


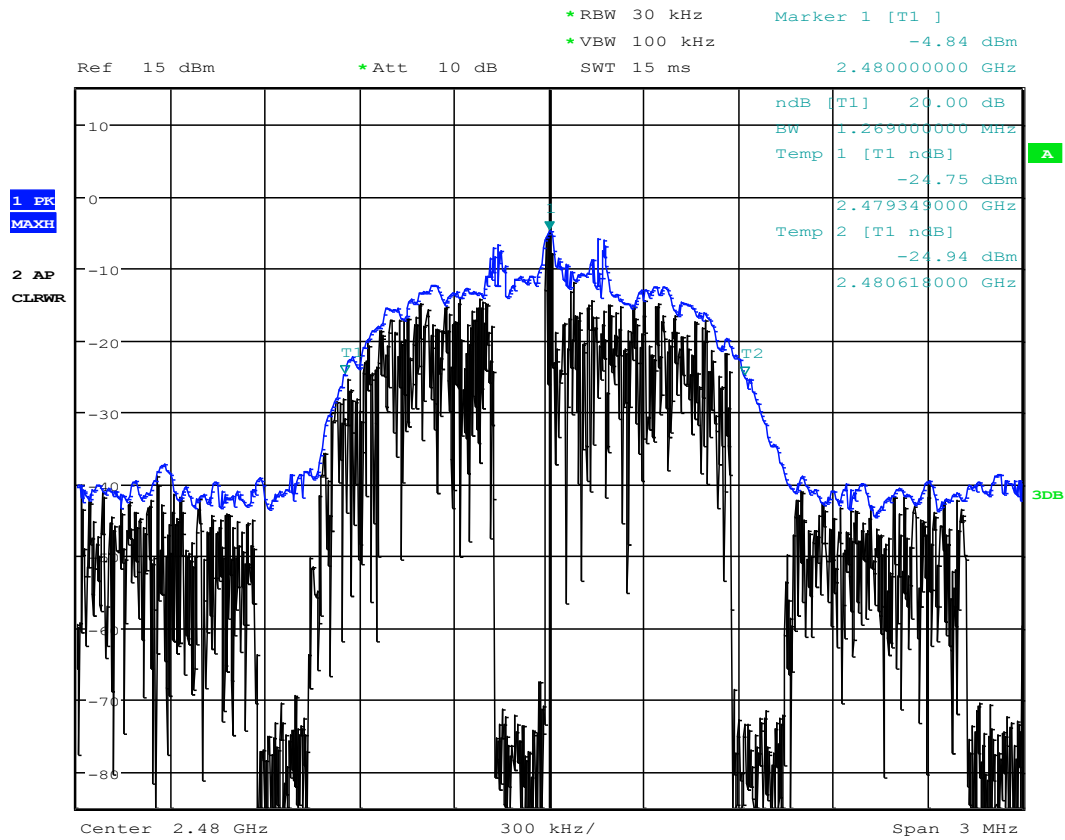
Test Data

Tabular Data

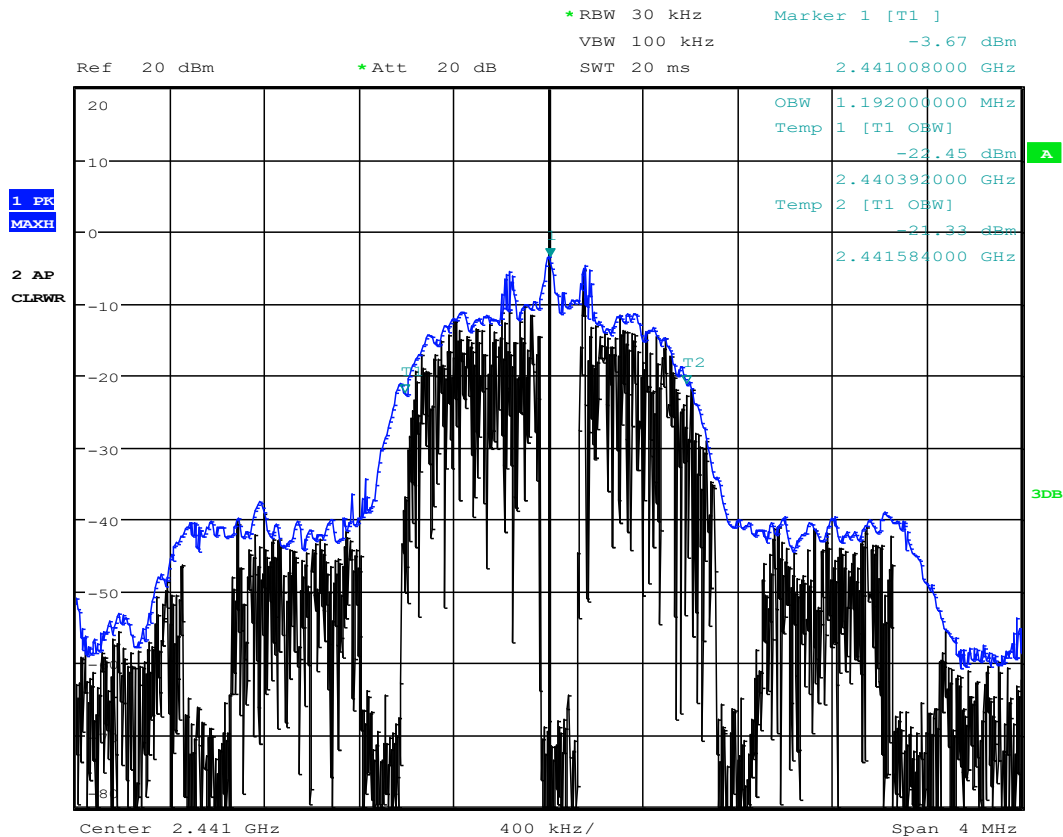
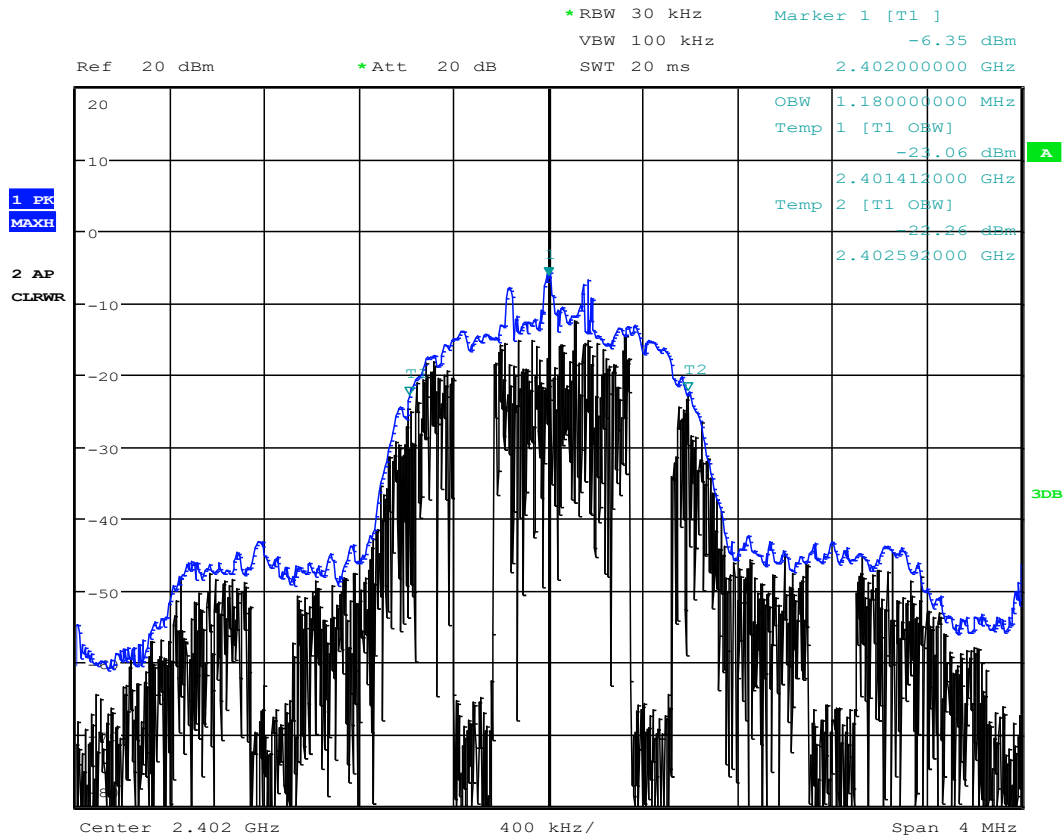
Data Rate	Frequency	20 dB BW	99% OBW
	MHz	MHz	MHz
BDR DM1	2402	0.782	0.834
BDR DM1	2441	0.864	0.825
BDR DM1	2480	0.864	0.828
BDR DM3	2402	0.964	0.905
BDR DM3	2441	0.948	0.903
BDR DM3	2480	0.957	0.900
BDR DH3	2402	0.854	0.862
BDR DH3	2441	0.857	0.864
BDR DH3	2480	0.857	0.861
BDR DM5	2402	0.949	0.864
BDR DM5	2441	0.954	0.882
BDR DM5	2480	0.957	0.851
BDR DH5	2402	0.856	0.872
BDR DH5	2441	0.957	0.864
BDR DH5	2480	0.851	0.867
EDR DM1	2402	0.756	0.840
EDR DM1	2441	0.758	0.825
EDR DM1	2480	0.755	0.831
EDR 2-DH3	2402	1.252	1.183
EDR 2-DH3	2441	1.254	1.182
EDR 2-DH3	2480	1.240	1.200
EDR 3-DH3	2402	1.228	1.181
EDR 3-DH3	2441	1.269	1.197
EDR 3-DH3	2480	1.263	1.206
EDR 2-DH5	2402	1.246	1.184
EDR 2-DH5	2441	1.260	1.194
EDR 2-DH5	2480	1.240	1.206
EDR 3-DH5	2402	1.237	1.175
EDR 3-DH5	2441	1.269	1.191
EDR 3-DH5	2480	1.269	1.206

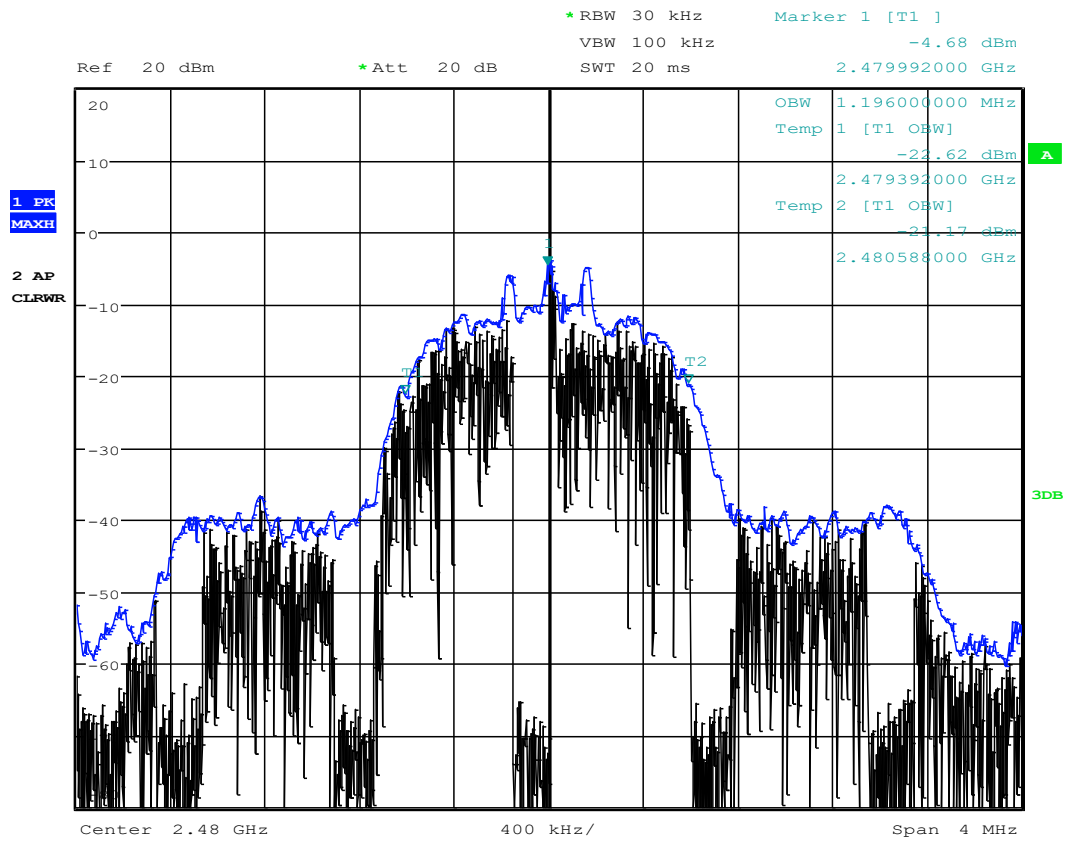
Sample 20 dB Plots [EDR 3-DH5]





Sample 99% Plots [EDR 3-DH5]





Output Power

Engineer: Aaron S. Froehlich

Test Date: 11/08/21

Test Procedure

The methods of ANSI C63.10 Clause 7.8.5 were utilized to demonstrate compliance of the DUT. All available data rates were tested and reported. The hopping function was disabled for this test; the DUT was tested while operating on a single channel.

Limit

47 CFR 15.247(b)(1) & RSS 247 5.4.b.

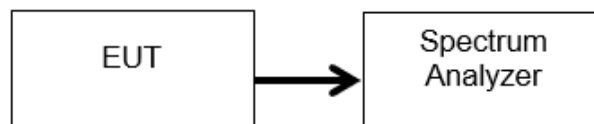
For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

The Spectrum Analyzer was set to the following:

Span	Approximately five times the 20 dB Bandwidth
RBW	> 20 dB BW
VBW	≥ RBW
Sweep	Auto
Detector	Peak
Trace Mode	Max Hold

The RF output power was measured using the spectrum analyzer's marker peak function

Test Setup



Test Data

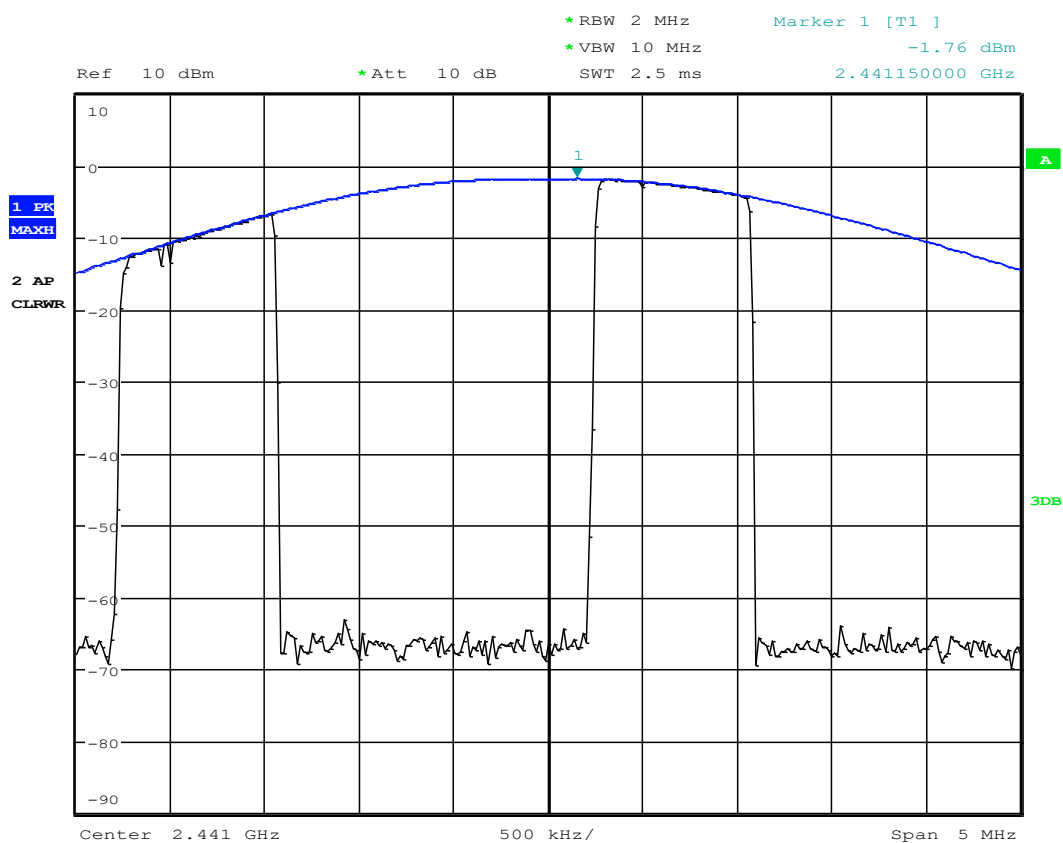
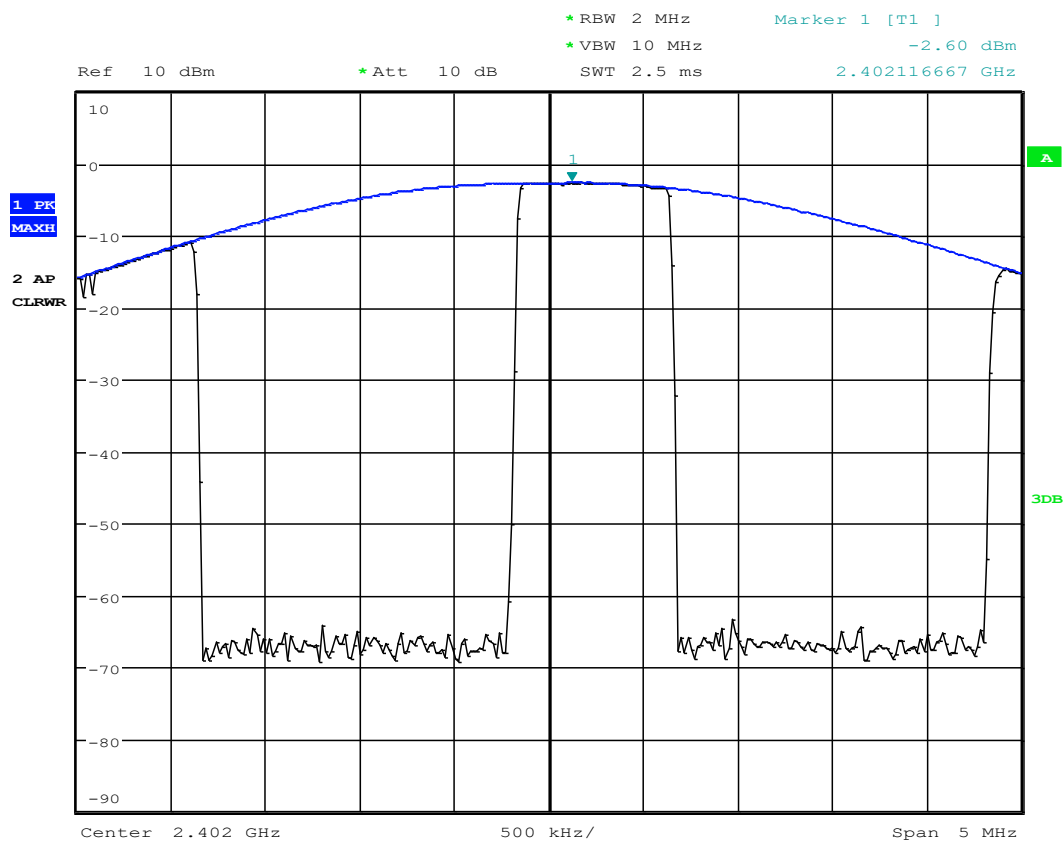
Tabular Data

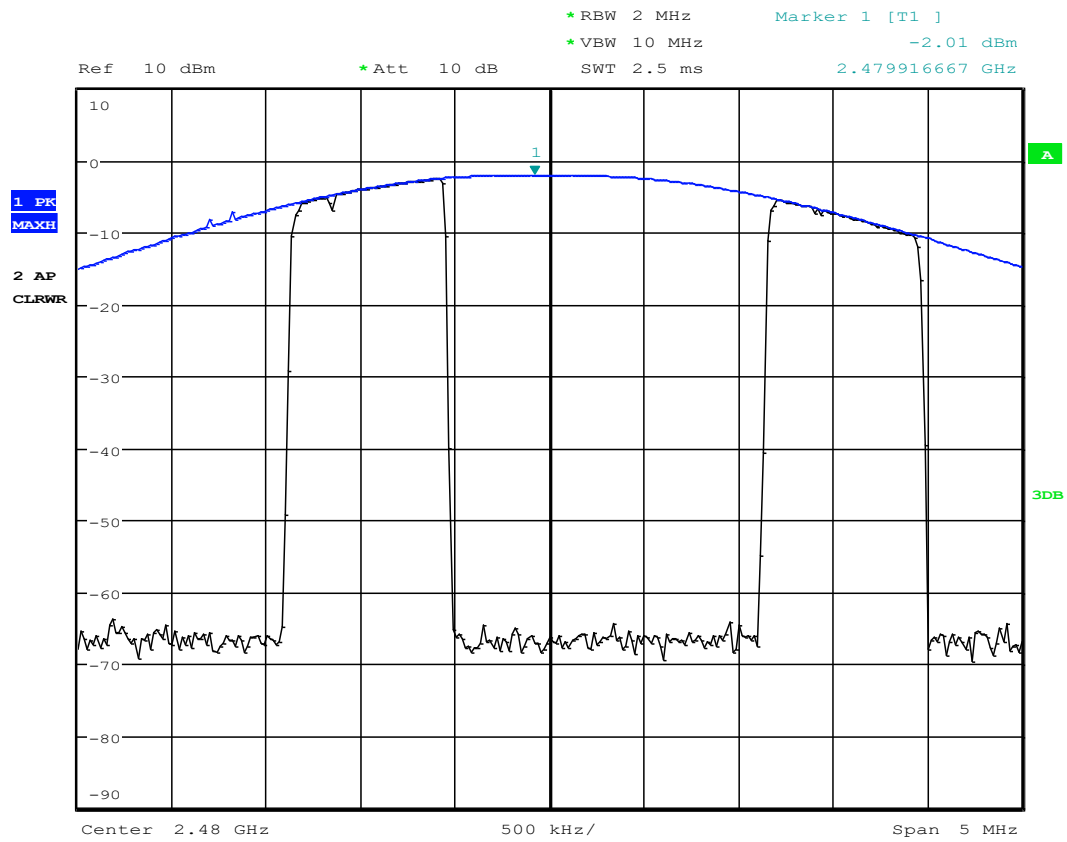
Data Rate	Frequency	Raw Pk	Atten	Final Pk	Final Pk
	MHz	dBm	dB	dBm	mW
BDR DM1	2402	-2.60	1.11	-1.49	0.71
BDR DM1	2441	-1.76	1.04	-0.72	0.85
BDR DM1	2480	-2.01	1.16	-0.85	0.82
BDR DM3	2402	-2.59	1.11	-1.48	0.71
BDR DM3	2441	-1.75	1.04	-0.71	0.85
BDR DM3	2480	-2.02	1.16	-0.86	0.82
BDR DH3	2402	-2.61	1.11	-1.50	0.71
BDR DH3	2441	-1.71	1.04	-0.67	0.86
BDR DH3	2480	-2.02	1.16	-0.86	0.82
BDR DM5	2402	-2.61	1.11	-1.50	0.71
BDR DM5	2441	-1.77	1.04	-0.73	0.84
BDR DM5	2480	-2.00	1.16	-0.84	0.82
BDR DH5	2402	-2.59	1.11	-1.48	0.71
BDR DH5	2441	-1.74	1.04	-0.70	0.85
BDR DH5	2480	-2.03	1.16	-0.87	0.82
EDR DM1	2402	-4.59	1.11	-3.48	0.45
EDR DM1	2441	-3.23	1.04	-2.19	0.60
EDR DM1	2480	-3.22	1.16	-2.06	0.62
EDR 2-DH3	2402	-3.98	1.11	-2.87	0.52
EDR 2-DH3	2441	-2.54	1.04	-1.50	0.71
EDR 2-DH3	2480	-2.68	1.16	-1.52	0.71
EDR 3-DH3	2402	-3.68	1.11	-2.57	0.55
EDR 3-DH3	2441	-2.40	1.04	-1.36	0.73
EDR 3-DH3	2480	-2.58	1.16	-1.42	0.72
EDR 2-DH5	2402	-3.99	1.11	-2.88	0.52
EDR 2-DH5	2441	-2.57	1.04	-1.53	0.70
EDR 2-DH5	2480	-2.72	1.16	-1.56	0.70
EDR 3-DH5	2402	-3.68	1.11	-2.57	0.55
EDR 3-DH5	2441	-2.40	1.04	-1.36	0.73
EDR 3-DH5	2480	-2.57	1.16	-1.41	0.72

Final Pk = Raw Pk + Atten

Maximum Output Power: -0.67 dBm, 0.86 mW

Sample Plots [BDR DM1]





Carrier Frequency Separation

Engineer: Aaron S. Froehlich

Test Date: 11/08/2021

Test Procedure

The test methods and settings of ANSI C63.10 Clause 7.8.2 were utilized to demonstrate compliance. The EUT was configured for BDR DM1 data rate during the test. Unmodulated frequency hopping was not possible.

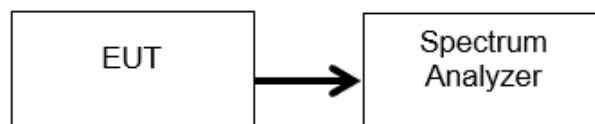
Markers were placed on the channel peak levels and the marker delta function was used to record the frequency separation between two adjacent channels.

Limit

47 CFR 15.247(a)(1) & RSS 247 5.1.b.

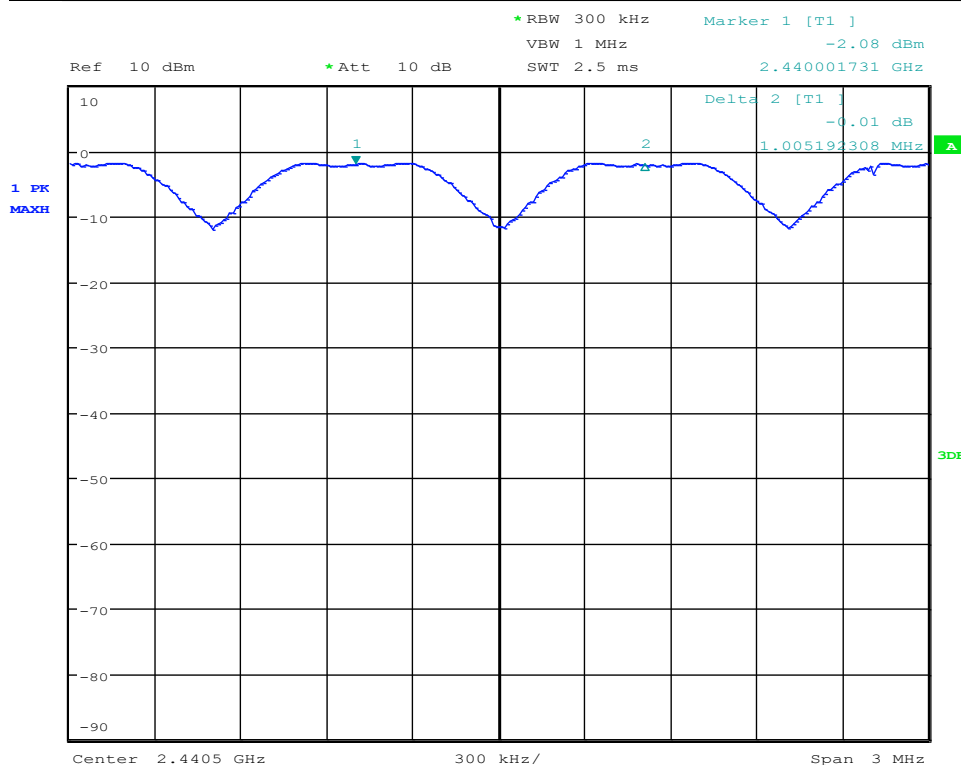
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

Test Setup



Test Data

Min 20 dB BW (MHz)	CFS (MHz)	Margin (MHz)	Result
0.755	1.005	-0.250	Compliant



Number of Hopping Frequencies

Engineer: Aaron S. Froehlich

Test Date: 11/08/21

Test Procedure

The test methods of ANSI C63.10 Clause 7.8.3 were utilized to demonstrate compliance. The EUT was configured for BDR DM1 with hopping during this test.

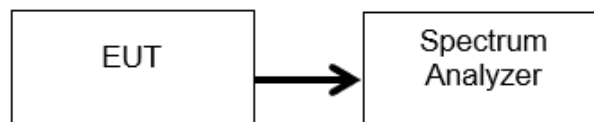
The number of frequencies were manually counted.

Limit

47 CFR 15.247(a)(1)(iii) & RSS 247 5.1.d.

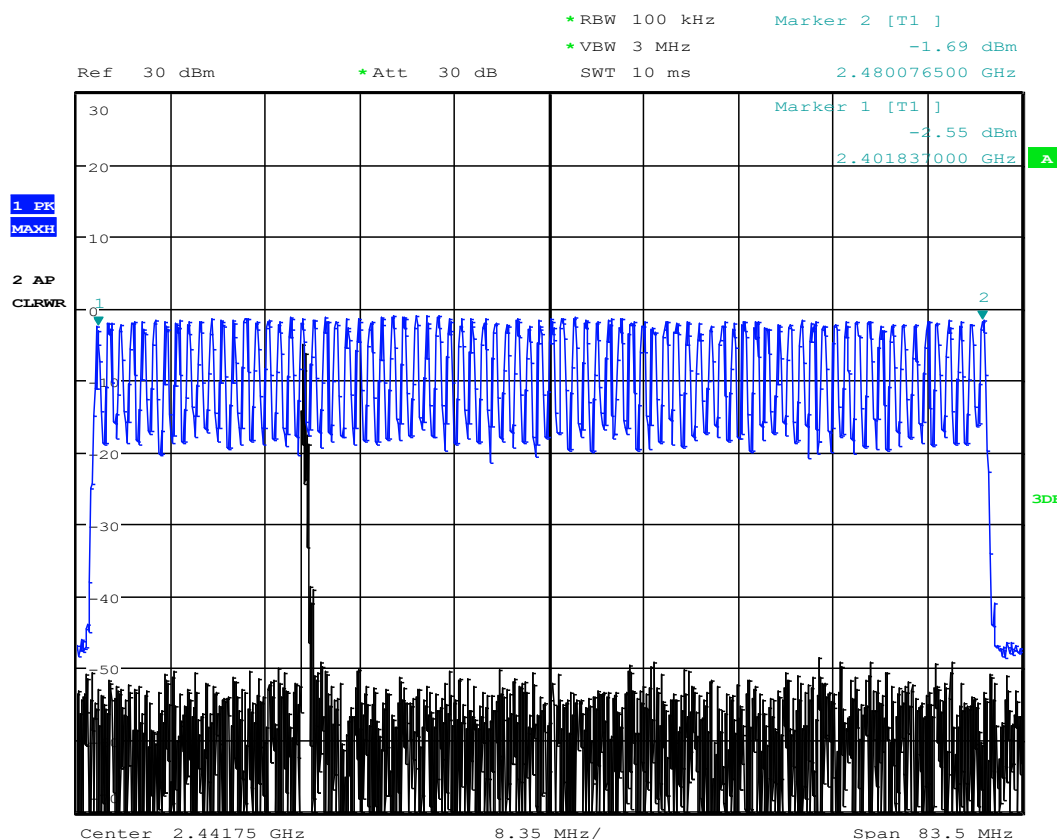
Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

Test Setup



Test Data

Number of Hopping Frequencies: 79



Time of Occupancy (Dwell Time)

Engineer: Aaron S. Froehlich

Test Date: 10/18/21

Test Procedure

The method of ANSI C63.10 Clause 7.8.4 was used to demonstrate compliance. Two measurements were made for each mode of operation. A short sweep to determine the transmit time per hop, followed by a longer sweep time to count the number of transmissions within the observation period. The number of hops in the longer sweep has been multiplied by the ratio of the requirement period to the sweep time. The average time of occupancy is calculated from the transmit time per hop multiplied by the number of hops in the period specified in the requirements.

Video Triggering with a negative offset was utilized to allow accurate time domain measurements.

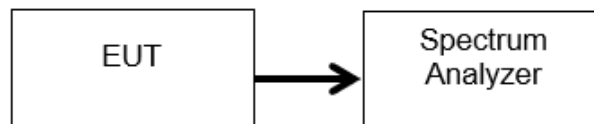
Limit

47 CFR 15.247(a)(1)(iii)

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

$$\text{Required Period} = 0.4 \text{ s} \cdot 79 \text{ channels} = 31.6 \text{ s}$$

Test Setup



Test Data

Tabular Data

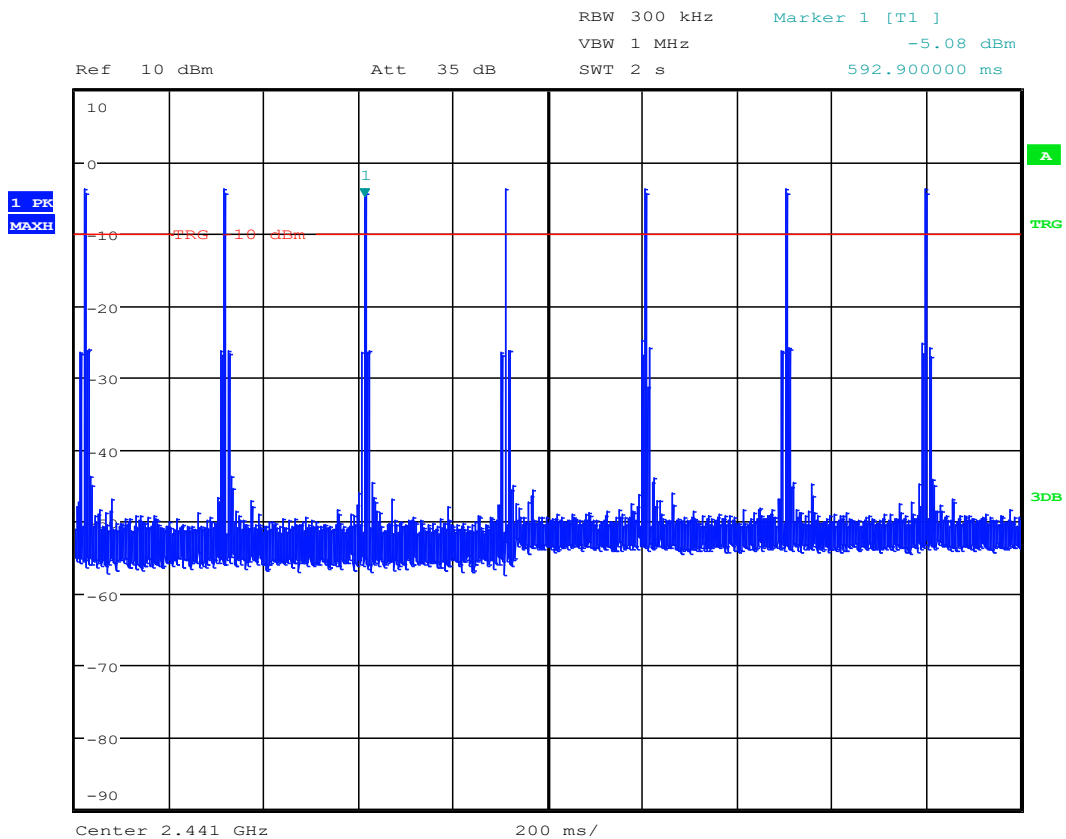
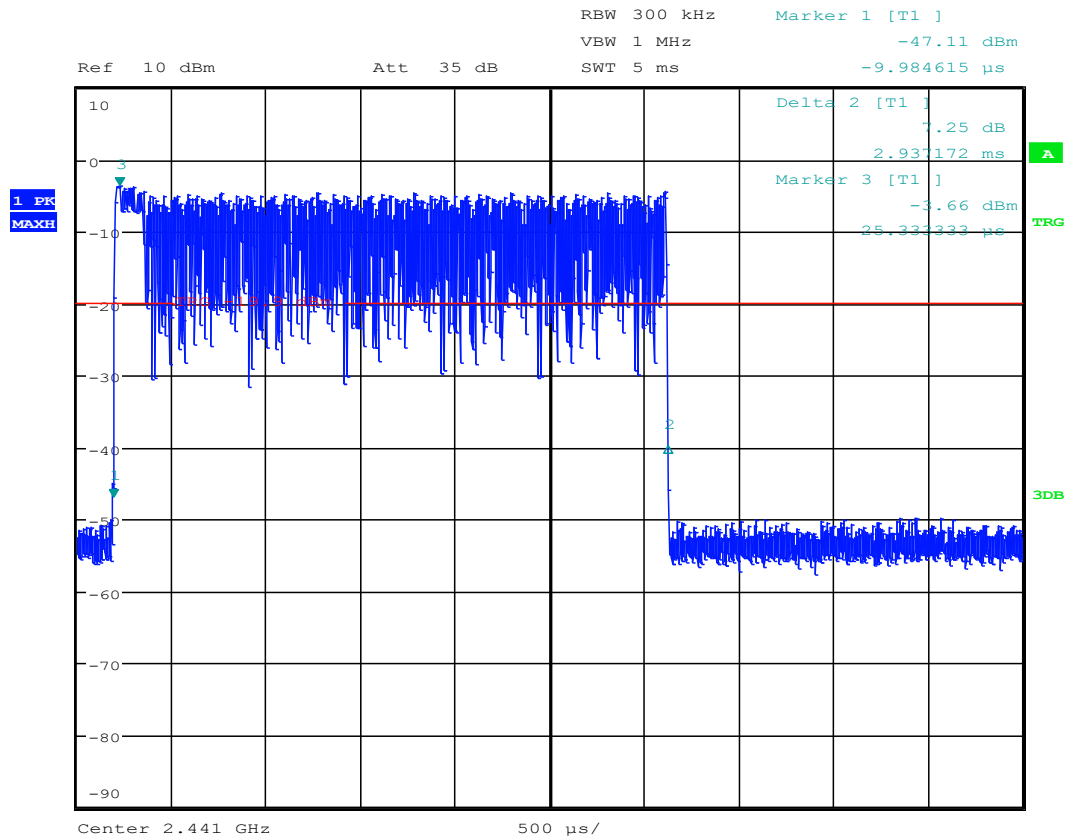
Rate	Packet Type	Start Time (μS)	Stop Time (μS)	Duration (μS)	Hops Observed	Required Period (S)	Sweep Time (S)	Total Hops	Total Occupancy (mS)	Limit (mS)	Margin (mS)	Result
BDR	DM1	-9.9846	420.1846	430.1692	5	31.6	0.5	316	135.93	400	-264.07	Compliant
	DM3	-9.9846	1678.197	1688.182	5	31.6	1	158	266.73	400	-133.27	Compliant
	DH3	-9.9846	1678.197	1688.182	5	31.6	1	158	266.73	400	-133.27	Compliant
	DM5	-9.9846	2926.274	2936.259	7	31.6	2	110.6	324.75	400	-75.25	Compliant
	DH5	-9.9846	2926.274	2936.259	7	31.6	2	110.6	324.75	400	-75.25	Compliant
EDR	DM1	-9.9846	413.1333	423.1179	5	31.6	0.5	316	133.71	400	-266.29	Compliant
	2-DH3	-9.9846	1687.172	1697.157	5	31.6	1	158	268.15	400	-131.85	Compliant
	3-DH3	-9.9846	1687.172	1697.157	5	31.6	1	158	268.15	400	-131.85	Compliant
	2-DH5	-9.9846	2937.172	2947.157	4	31.6	1	126.4	372.52	400	-27.48	Compliant
	3-DH5	-9.9846	2937.172	2947.157	7	31.6	2	110.6	325.96	400	-74.04	Compliant

Duration = Stop Time – Start Time

Total Hops = Hops Observed • Required Period / Sweep Time

Total Occupancy = Duration • Total Hops

Sample Plots [EDR 3-DH5]



Duty Cycle

Engineer: Aaron S. Froehlich

Test Date: 10/22/21

Test Procedure

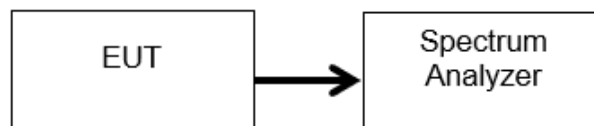
Duty Cycle was measured using the method of ANSI C63.10 Clause 11.6 option b.

Limit

None – This data has been used to calculate Duty Cycle Correction Factors.

Span	Zero Span
RBW	$RBW \geq OBW$
VBW	$\geq RBW$
Detector	Peak

Test Setup

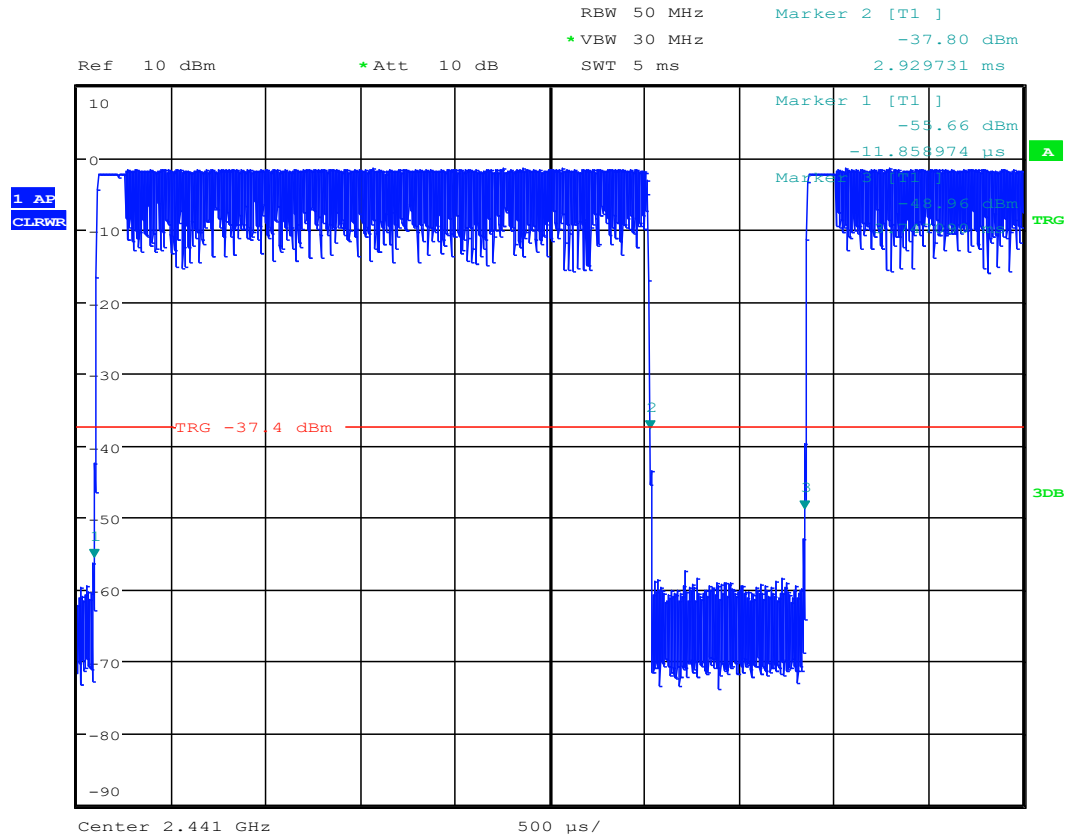


Test Data

Tabular Data

Data Rate	Frequency	Tx On	Tx Off	On Time	Tx On 2	Period	Duty Cycle
	MHz	s	s	s	s	s	%
BDR DM1	2441	-11.9E-6	413.7E-6	425.6E-6	1.2E-3	1.3E-3	34.0%
BDR DM3	2441	-11.9E-6	1.7E-3	1.7E-3	2.5E-3	2.5E-3	67.3%
BDR DH3	2441	-11.9E-6	1.7E-3	1.7E-3	2.5E-3	2.5E-3	67.3%
BDR DM5	2441	-11.9E-6	2.9E-3	2.9E-3	3.7E-3	3.8E-3	78.0%
BDR DH5	2441	-11.9E-6	2.9E-3	2.9E-3	3.7E-3	3.8E-3	78.0%
EDR DM1	2441	-11.9E-6	405.7E-6	417.6E-6	1.2E-3	1.3E-3	33.4%
EDR 2-DH3	2441	-11.9E-6	1.7E-3	1.7E-3	2.5E-3	2.5E-3	67.4%
EDR 3-DH3	2441	-11.9E-6	1.7E-3	1.7E-3	2.5E-3	2.5E-3	67.4%
EDR 2-DH5	2441	-11.9E-6	2.9E-3	2.9E-3	3.7E-3	3.8E-3	78.3%
EDR 3-DH5	2441	-11.9E-6	2.9E-3	2.9E-3	3.7E-3	3.8E-3	78.3%

Sample Plot [EDR 2-DH5]



Emissions at Band Edges

Engineer: Aaron S. Froehlich

Test Date: 11/01/21

Test Procedure

Clause 7.8.6 of ANSI C63.10 directs the use of the methods of Clause 6.10 for Band Edge measurements of DSS devices, in both single channel and hopping modes of operation. The relative method of Clause 6.10.4 was used to demonstrate Band Edge Compliance with the 2400-2483.5 MHz Band.

Additionally, the method of Clause 6.10.5.2 was used to demonstrate Restricted-Band Band-Edge for the adjacent 2310-2390 MHz, and 2483.5-2500 MHz bands.

Both measurements were made using antenna port conducted measurements. The Restricted-Band Band-Edge data has been converted into equivalent radiated field strengths using the equation of Clause 11.12.2.2, as a reference level offset (CF). Per Clause 11.12.2.6 a minimum antenna gain (AG) of 2 dBi has been applied. Finally, duty cycle correction factors (DCCF) and worst case cable losses (CL) were also accounted for in the final Reference Level offset. Peak compliance has been demonstrated with a Max Hold on trace 1; Average compliance with an RMS detector averaged over 100 sweeps of Trace 2.

RB BE Offset Calculations

Data Rate	CF dB	CL dB	DCCF dB	AG dBi	Offset dB
BDR DM1	-11.742	2.450	4.683	2.000	-2.610
BDR DM3	-11.742	2.450	1.719	2.000	-5.574
BDR DH3	-11.742	2.450	1.719	2.000	-5.574
BDR DM5	-11.742	2.450	1.079	2.000	-6.213
BDR DH5	-11.742	2.450	1.079	2.000	-6.213
EDR DM1	-11.742	2.450	4.765	2.000	-2.527
EDR 2-DH3	-11.742	2.450	1.714	2.000	-5.579
EDR 3-DH3	-11.742	2.450	1.714	2.000	-5.579
EDR 2-DH5	-11.742	2.450	1.065	2.000	-6.228
EDR 3-DH5	-11.742	2.450	1.065	2.000	-6.228

$$CF = -20 \cdot \log_{10}(D) + 104.8$$

Where D = 3 meters

$$DCCF = 10 \cdot \log_{10}(1/\text{Duty Cycle})$$

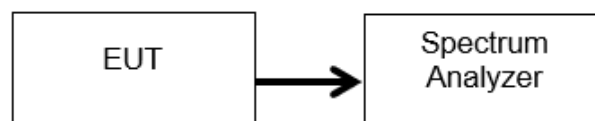
$$\text{Offset} = CF + CL + DCCF + AG$$

Limits

47 CFR 15.247(d) & RSS 247 Section 5.5

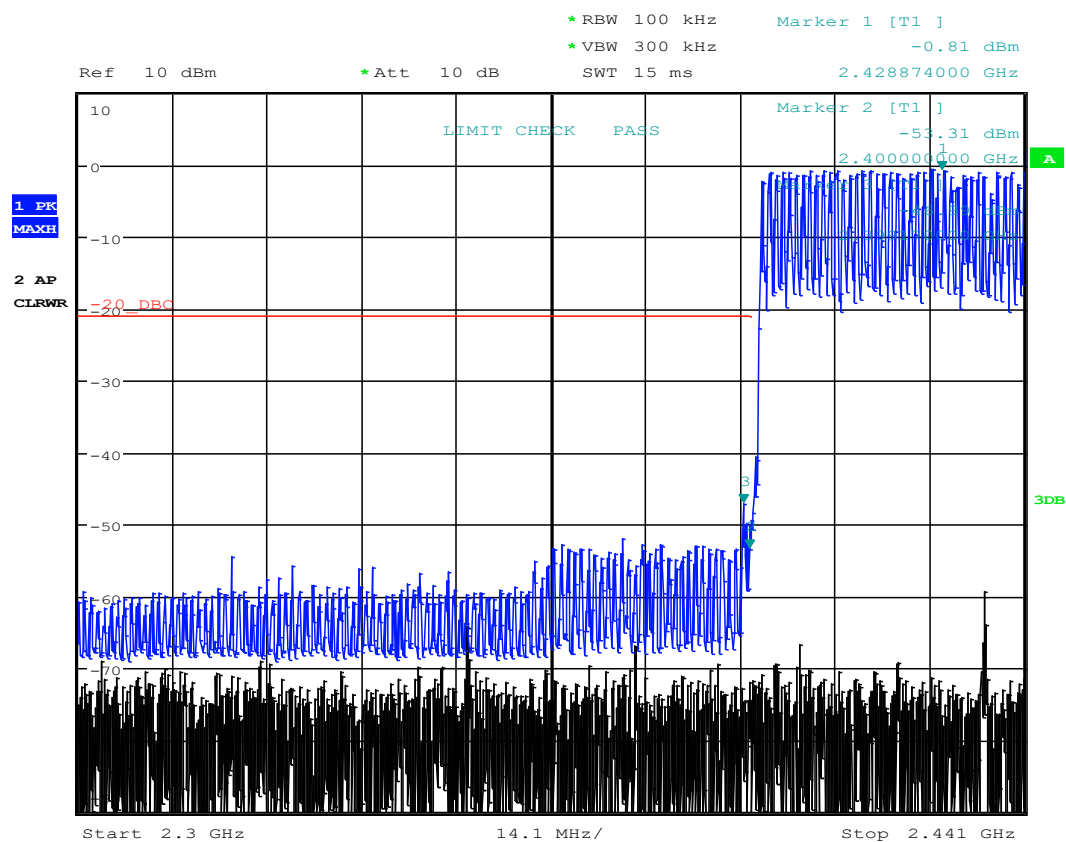
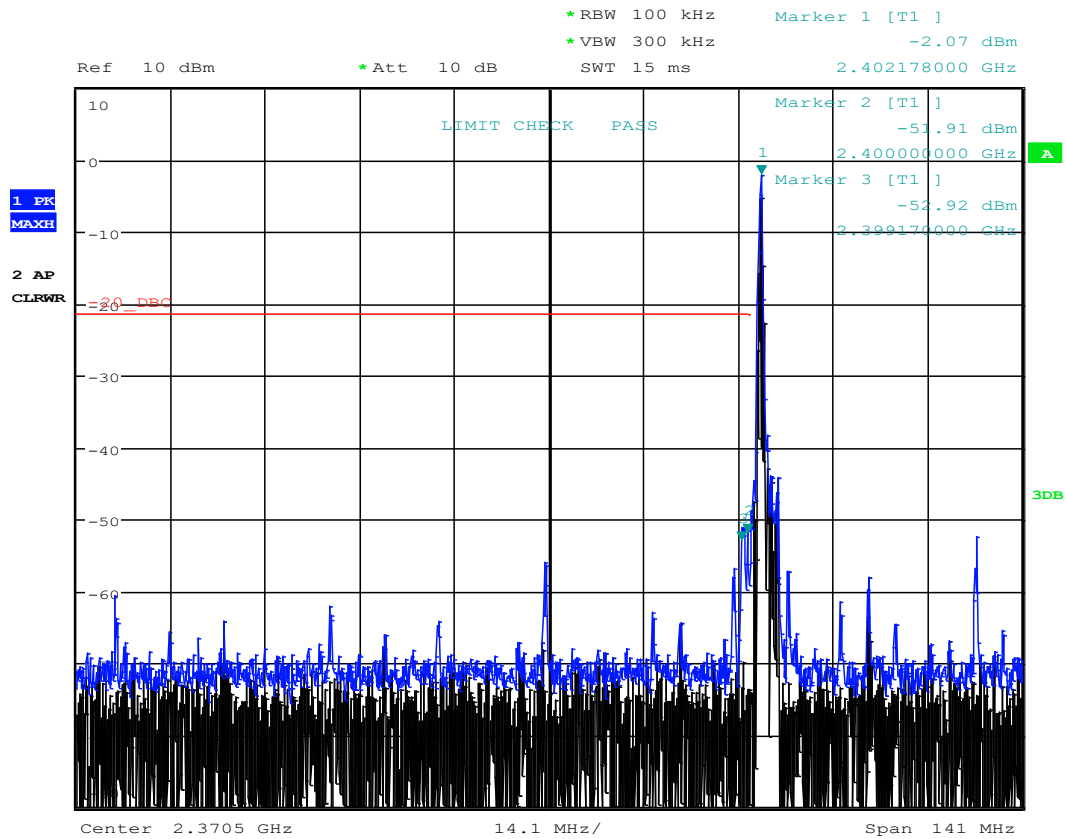
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands, as defined in [§ 15.205\(a\)](#), must also comply with the radiated emission limits specified in [§ 15.209\(a\)](#) (see [§ 15.205\(c\)](#)).

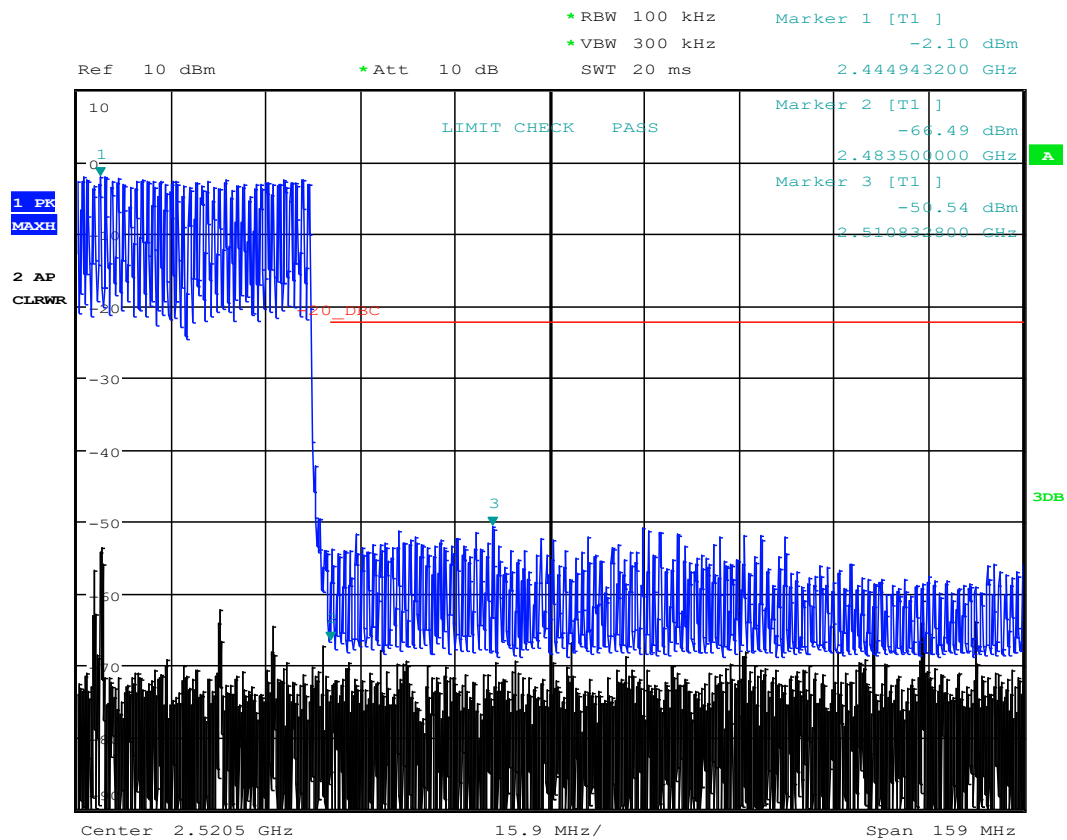
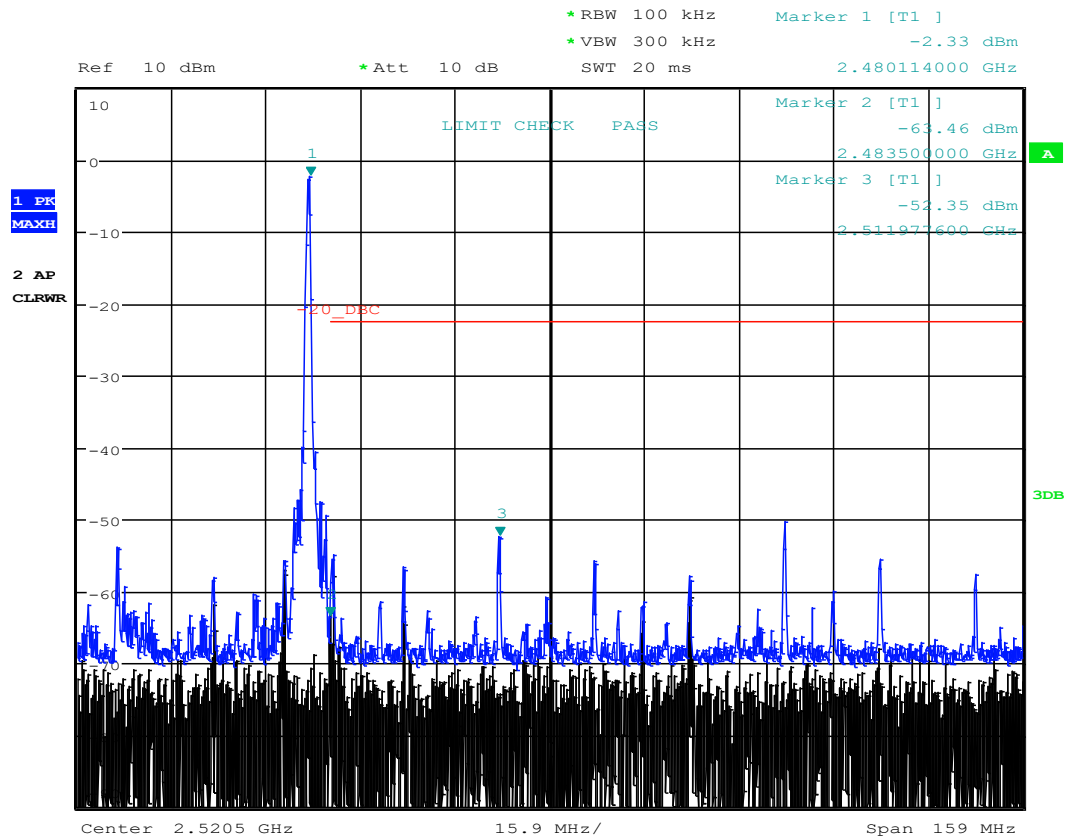
Test Setup



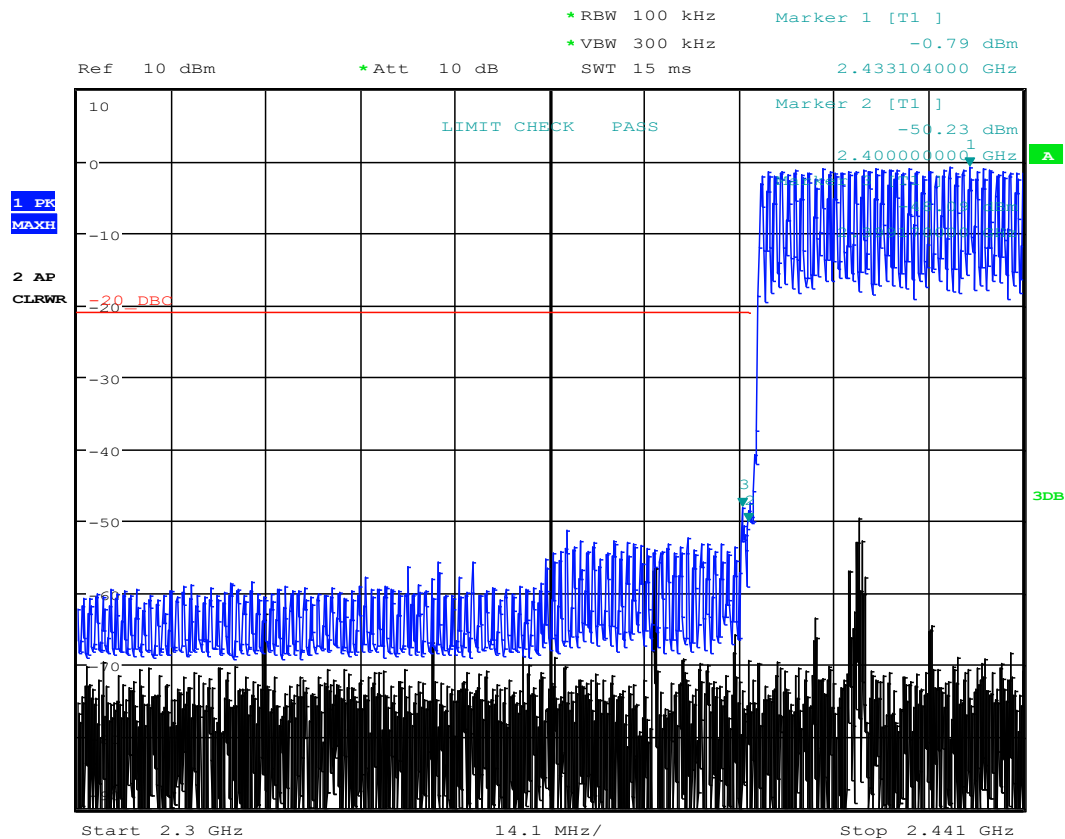
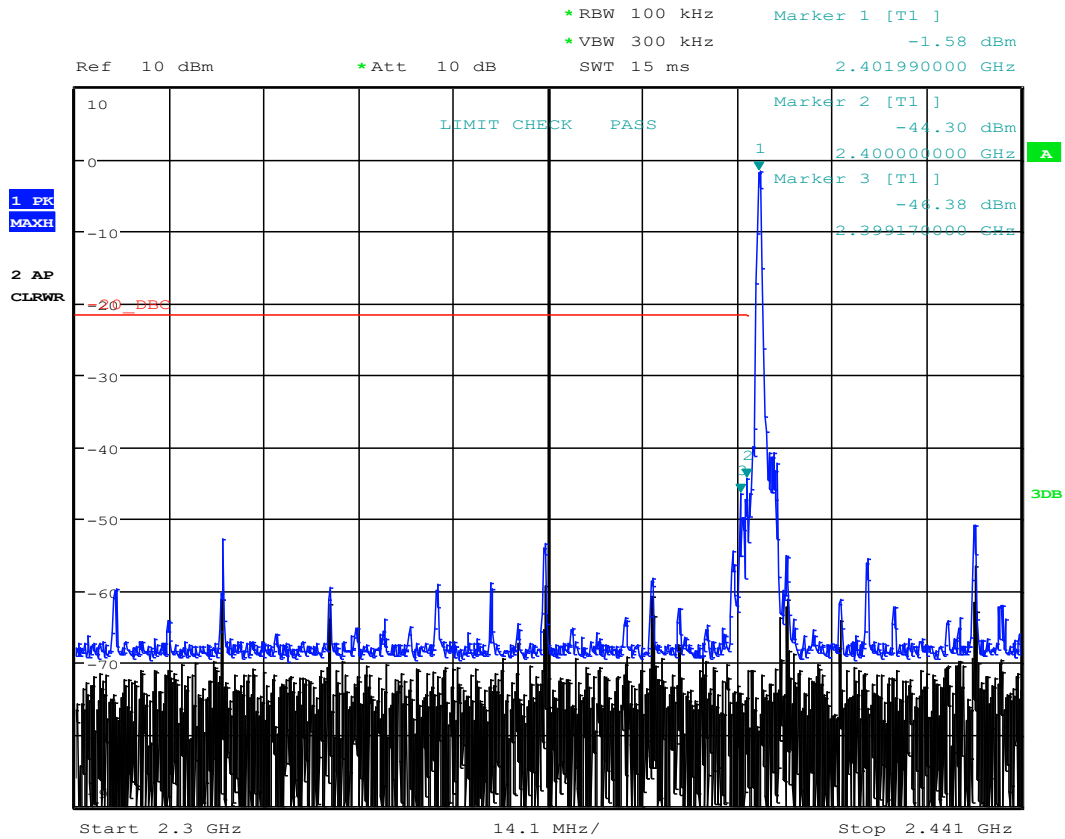
Band Edge Test Data

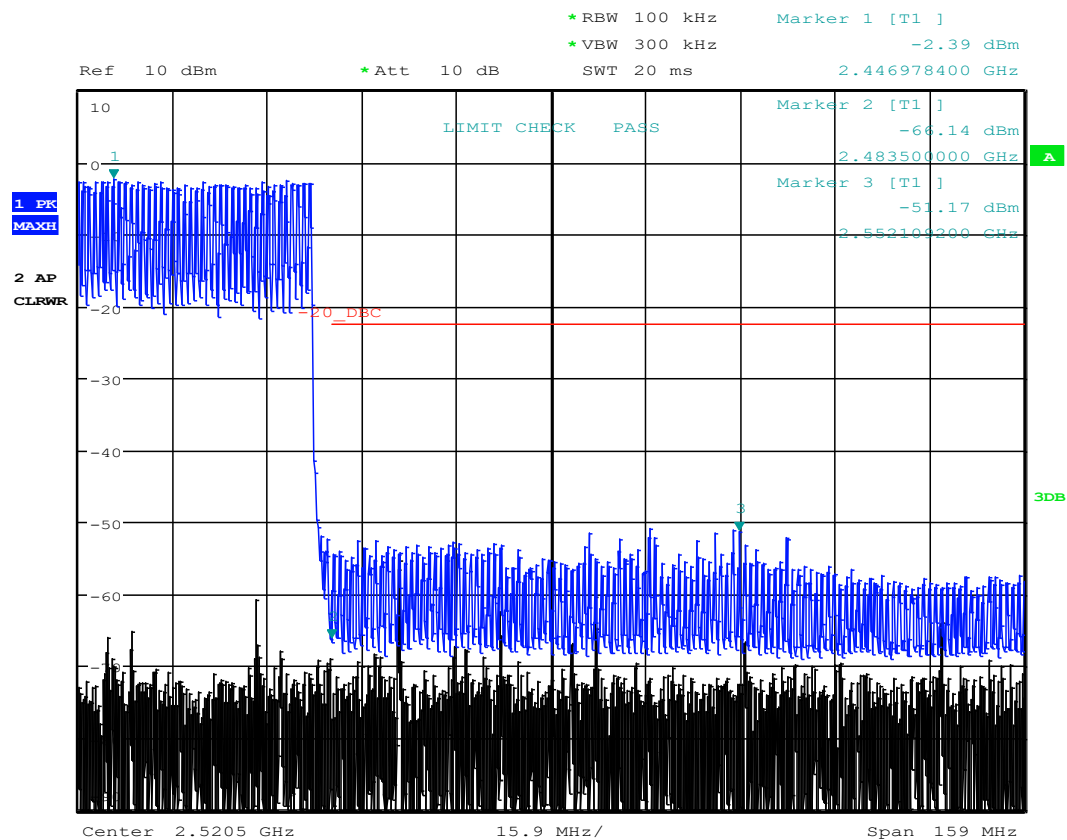
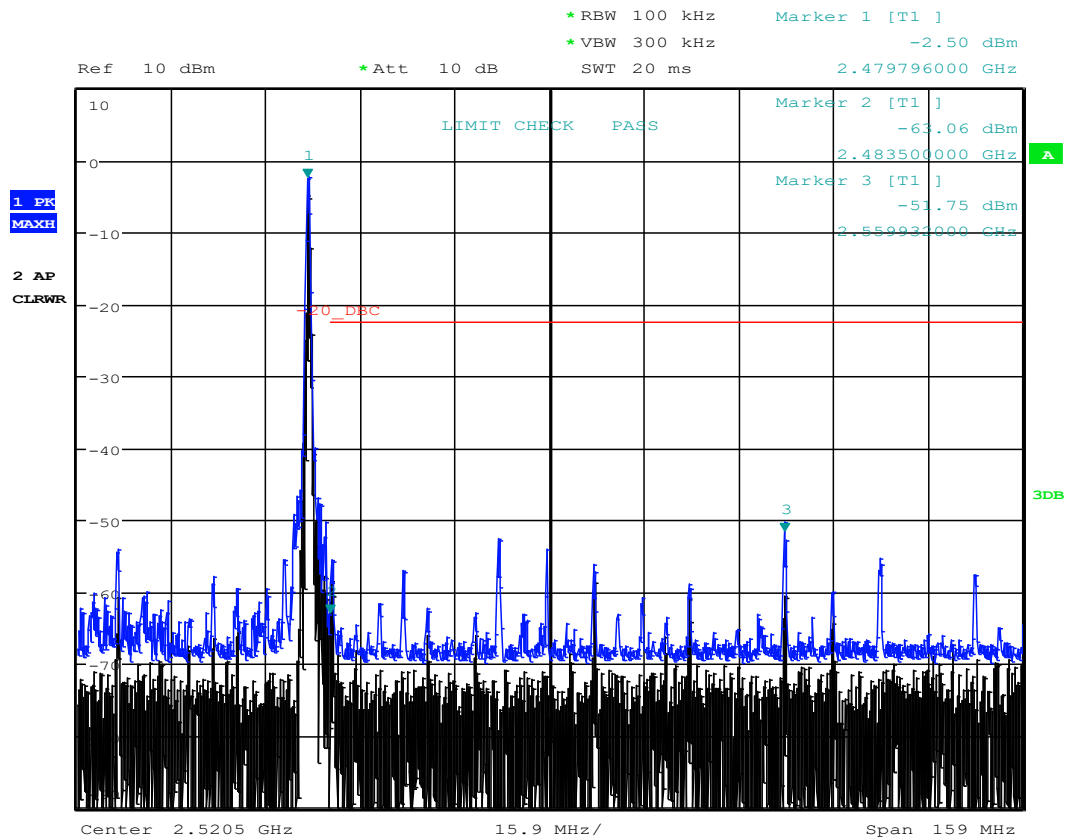
BDR DM1



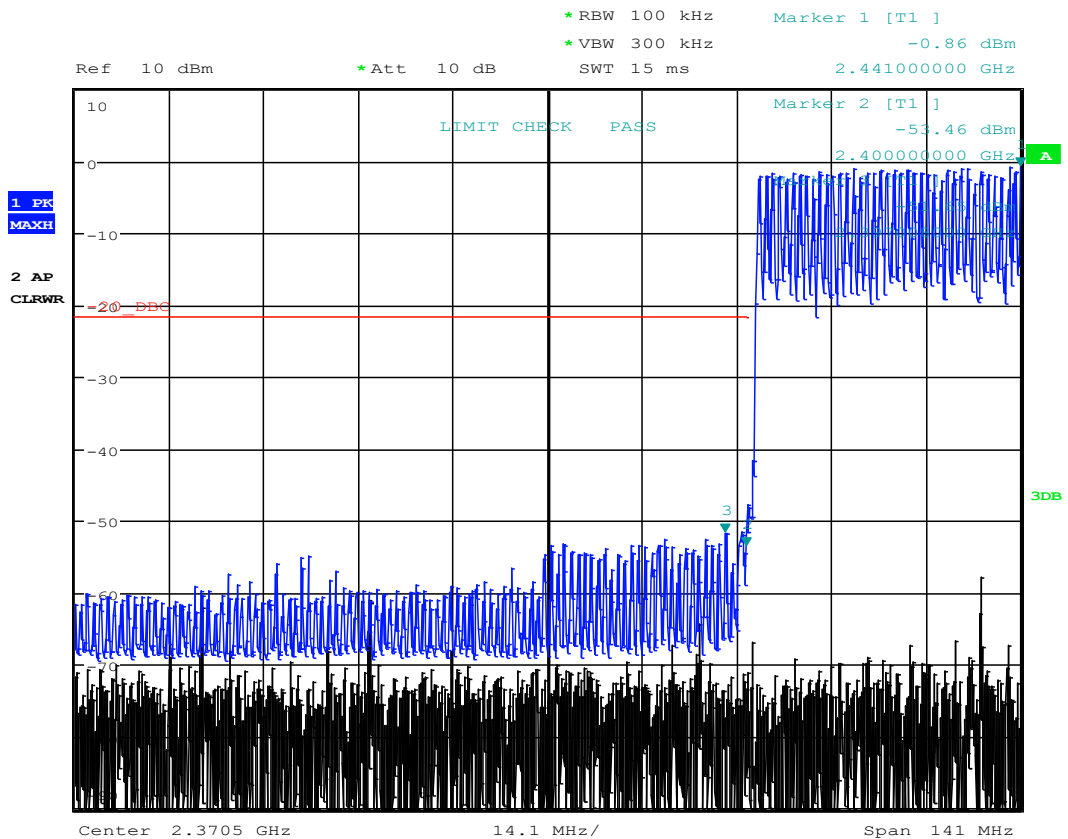
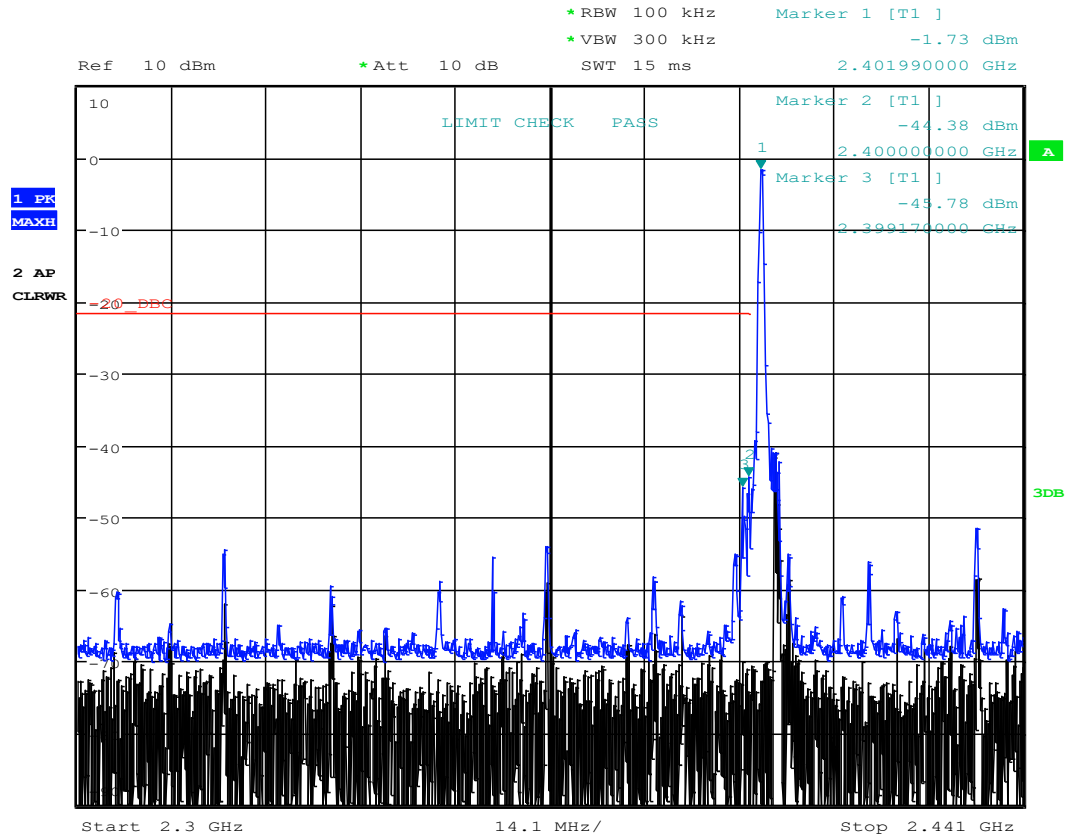


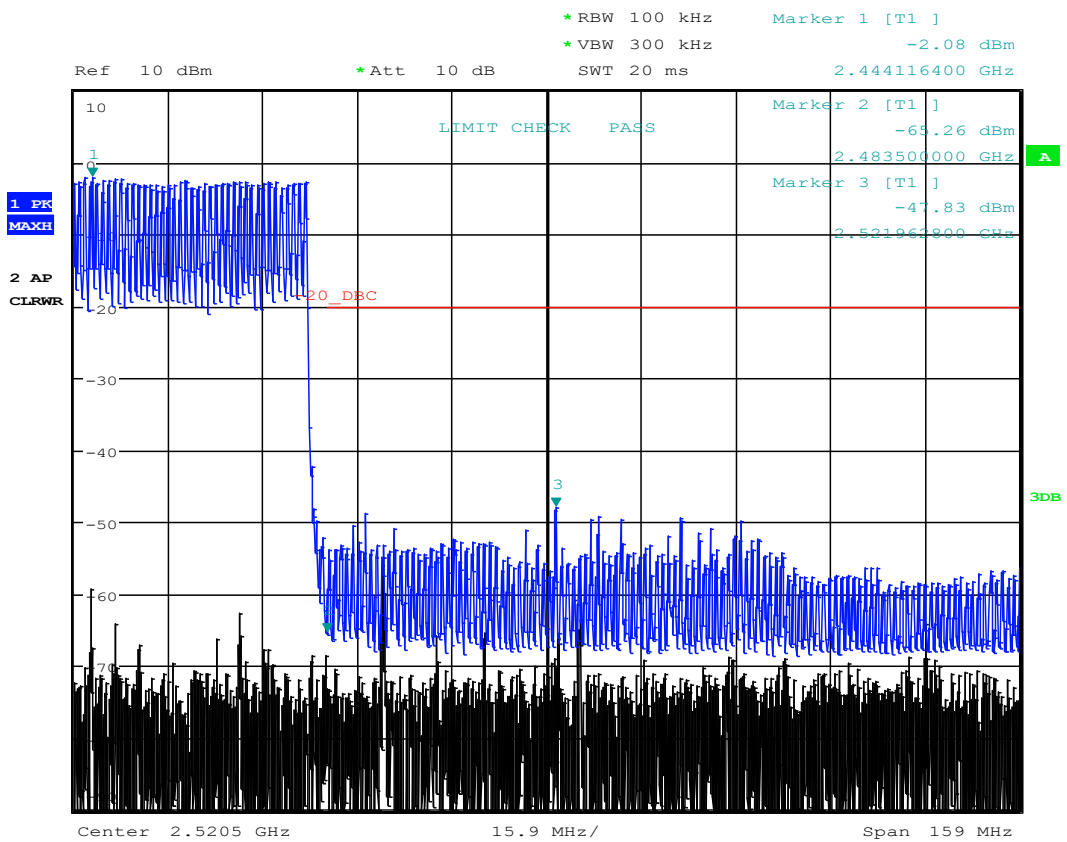
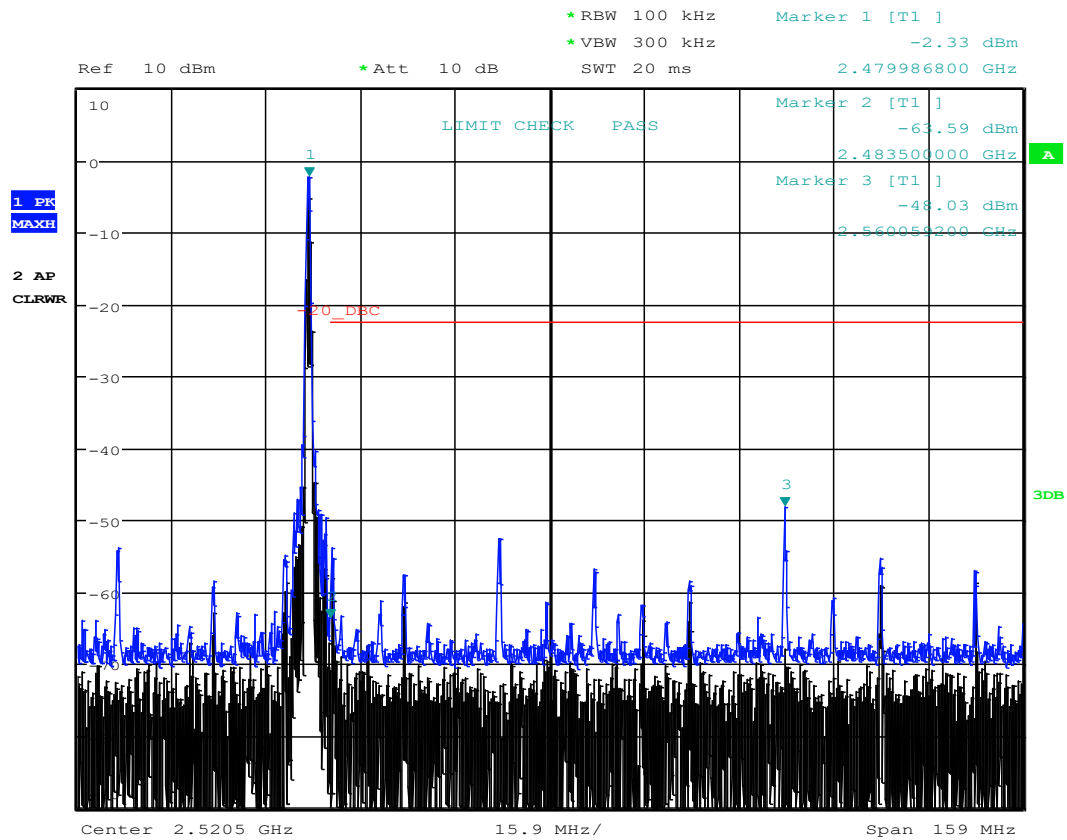
BDR DM3



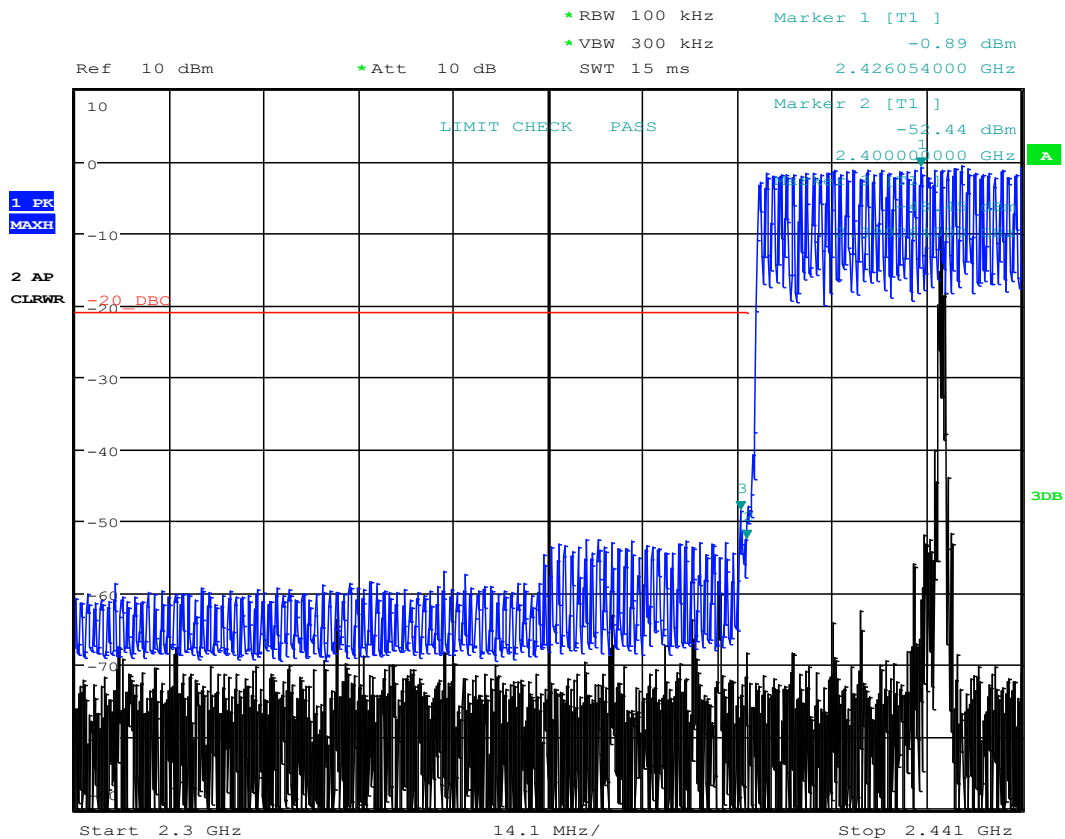
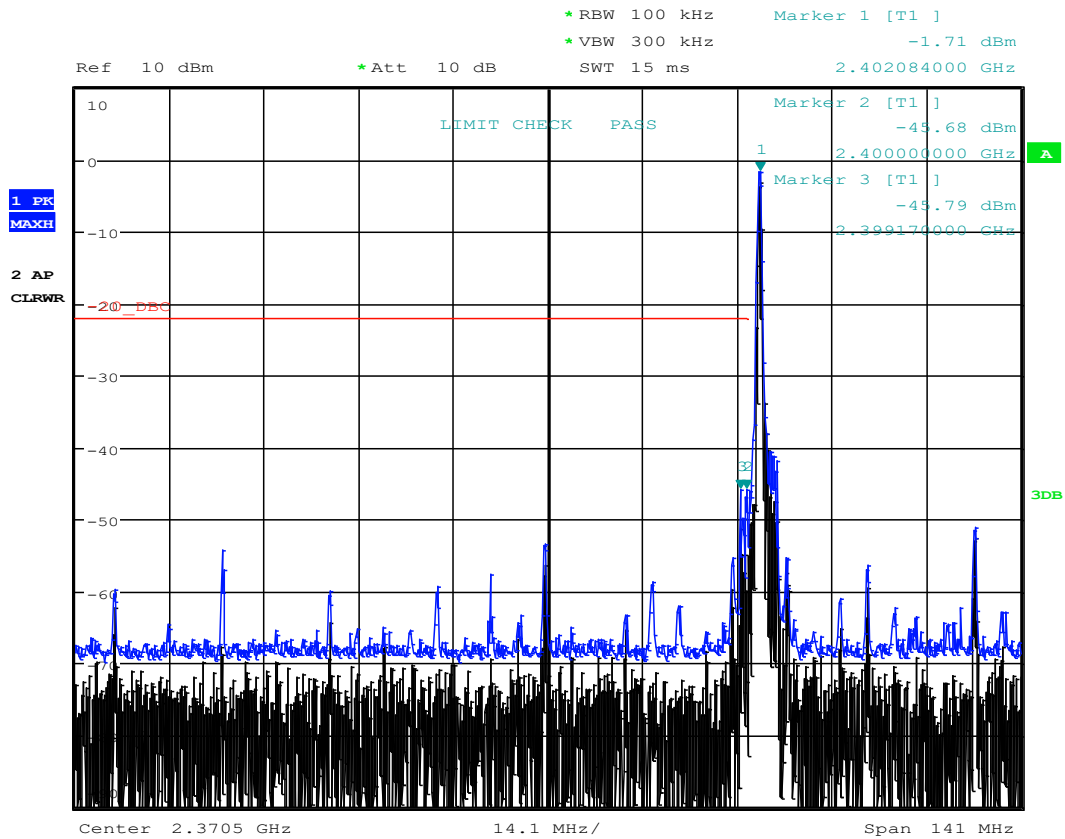


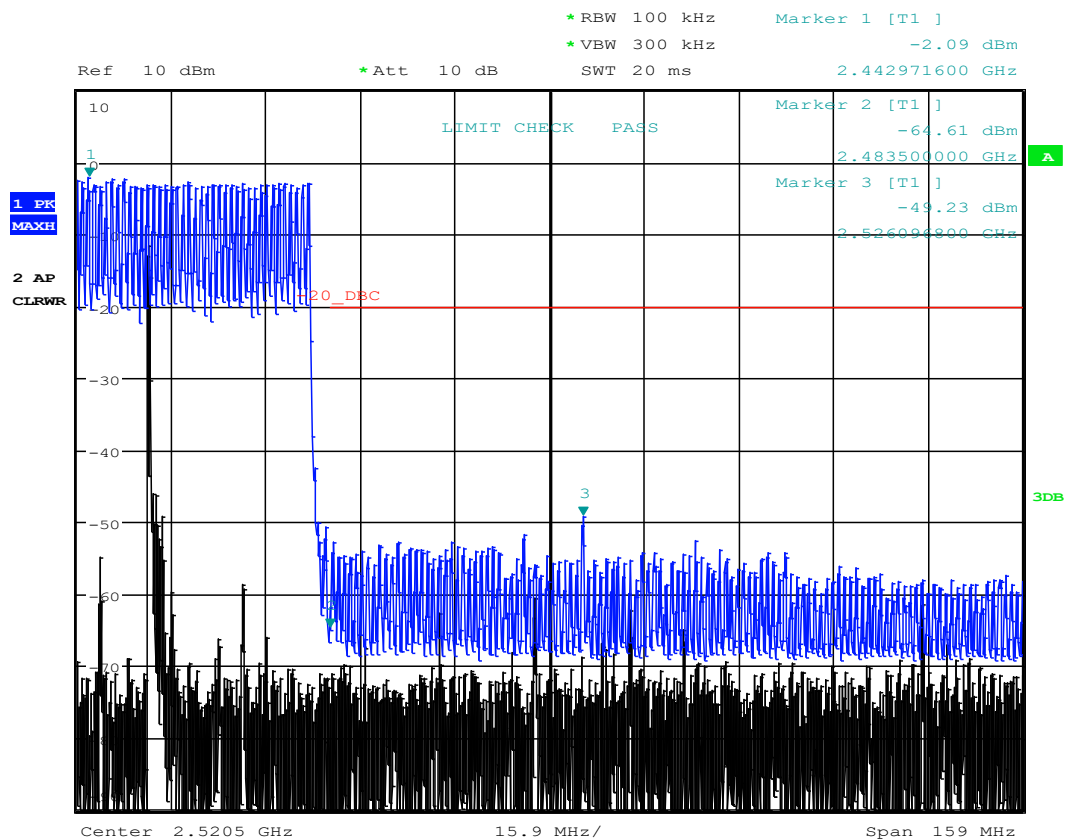
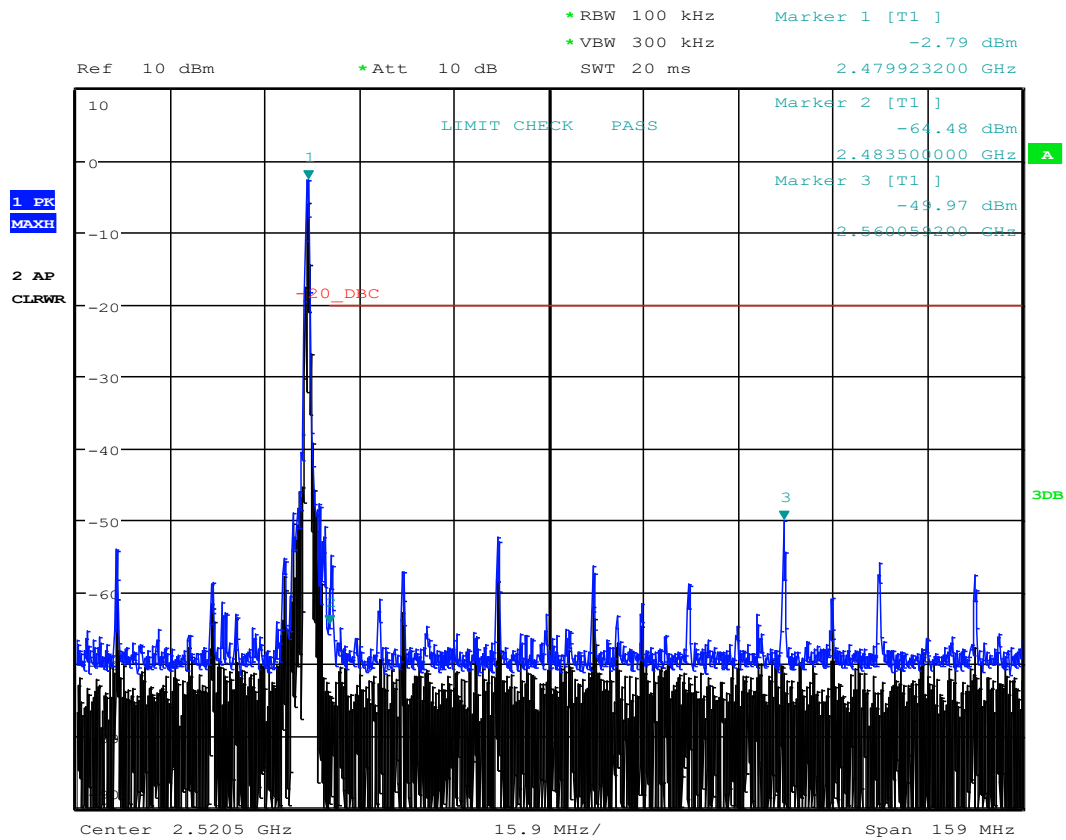
BDR DH3



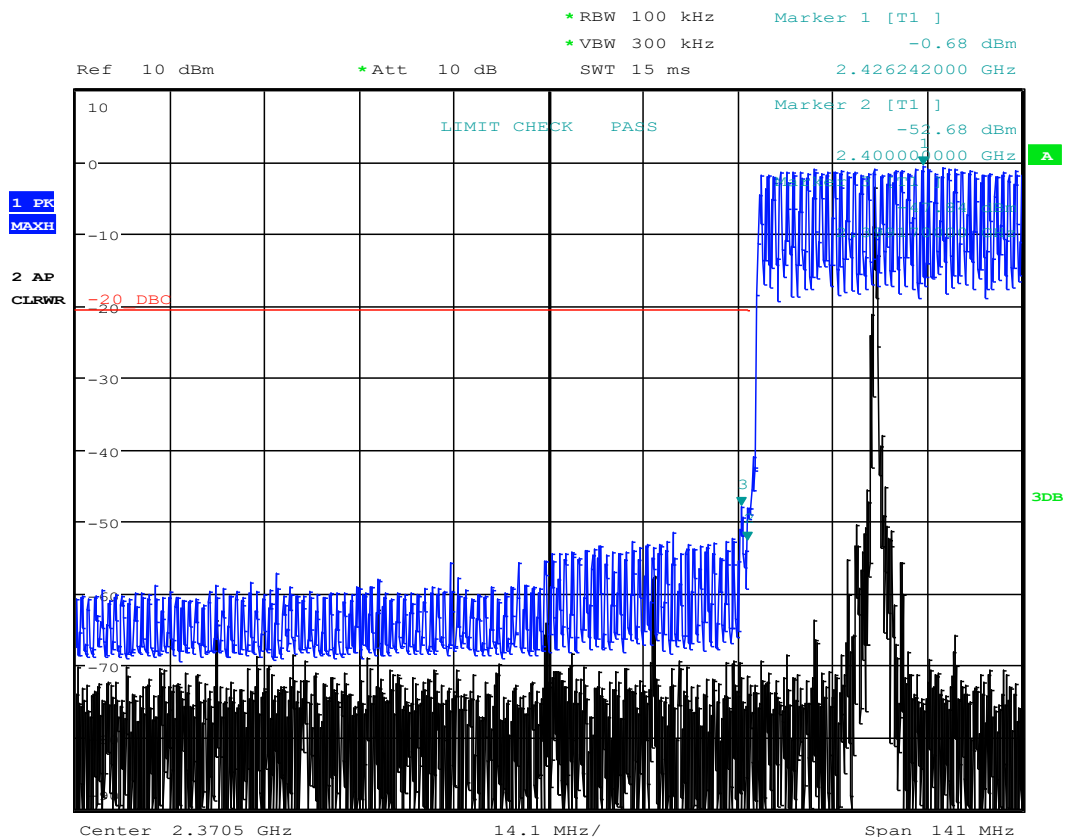
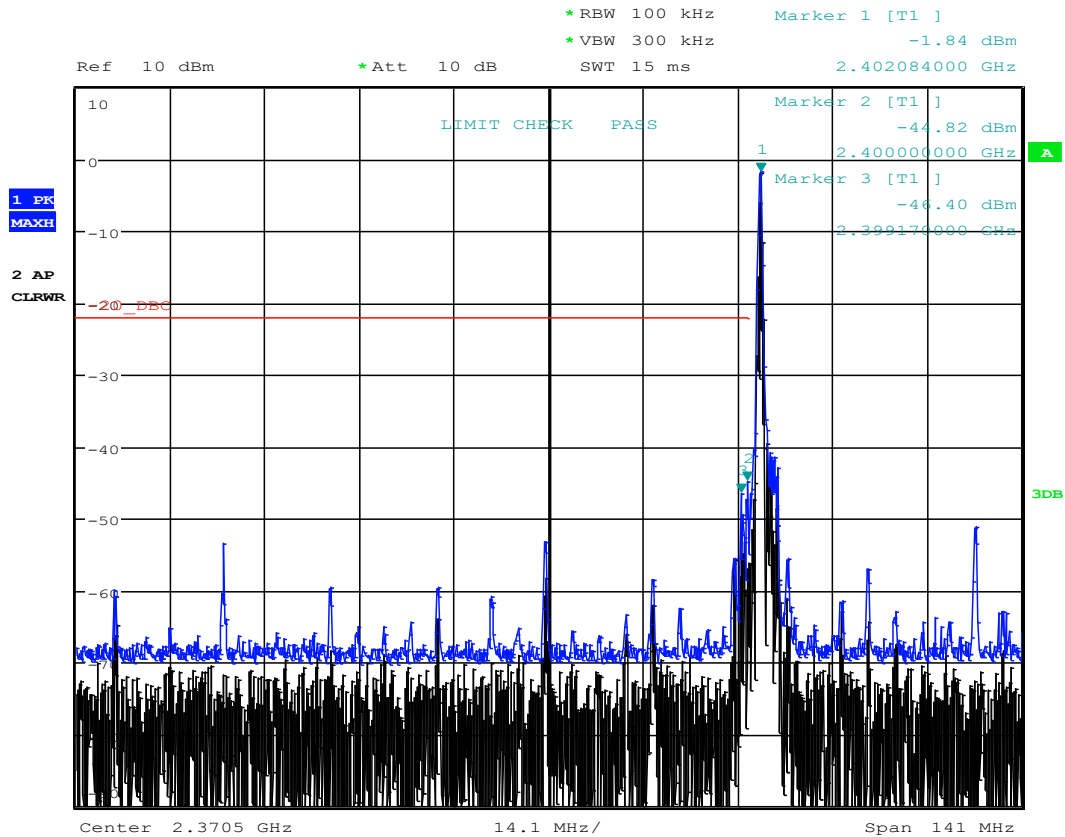


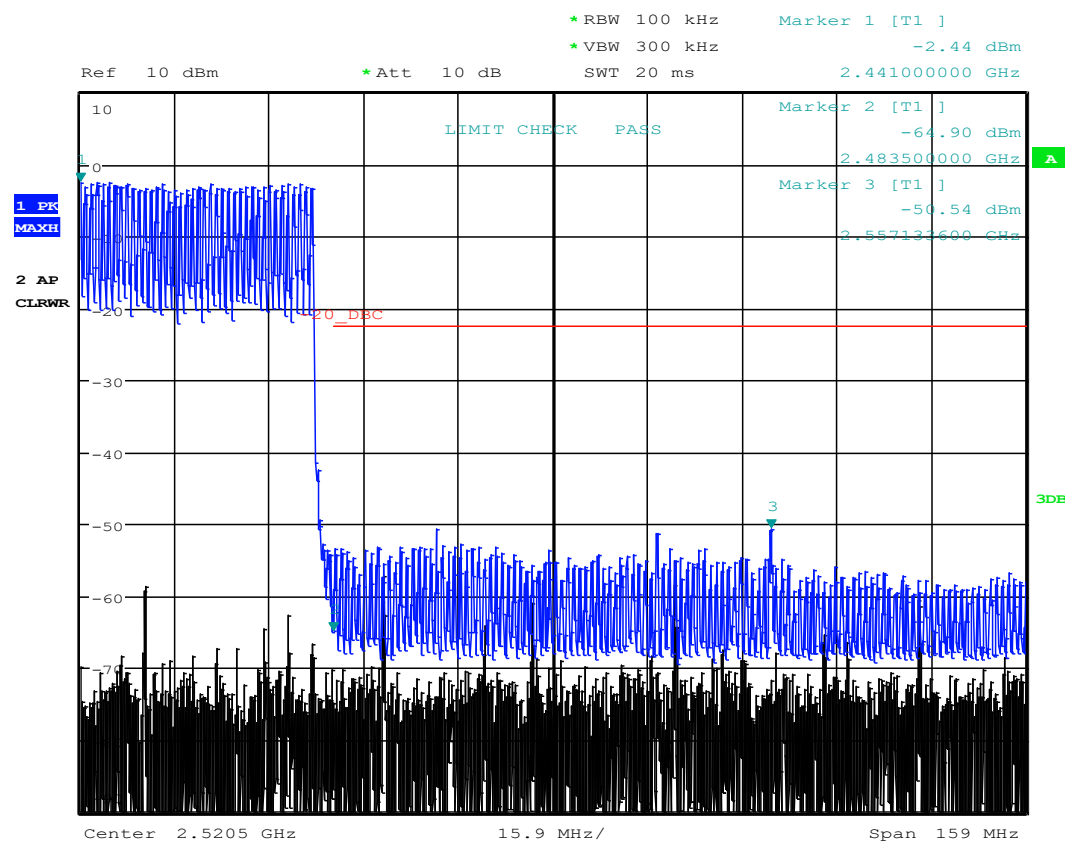
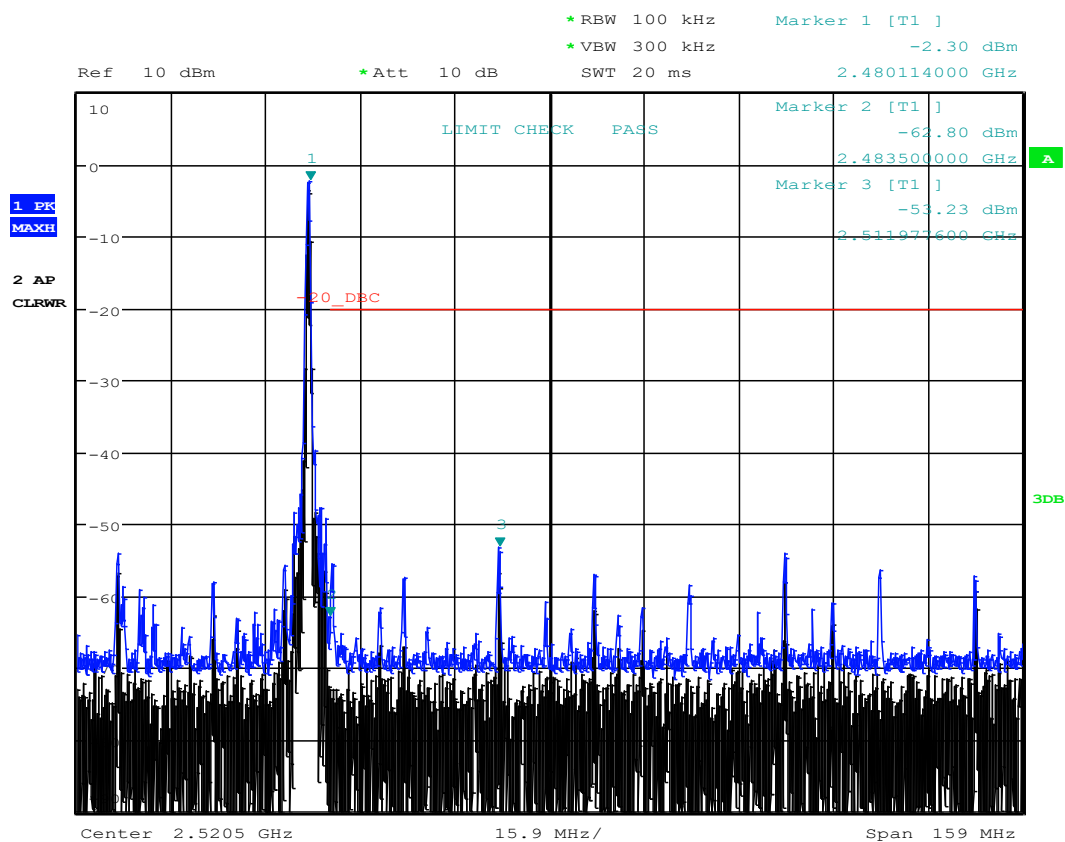
BDR DM5



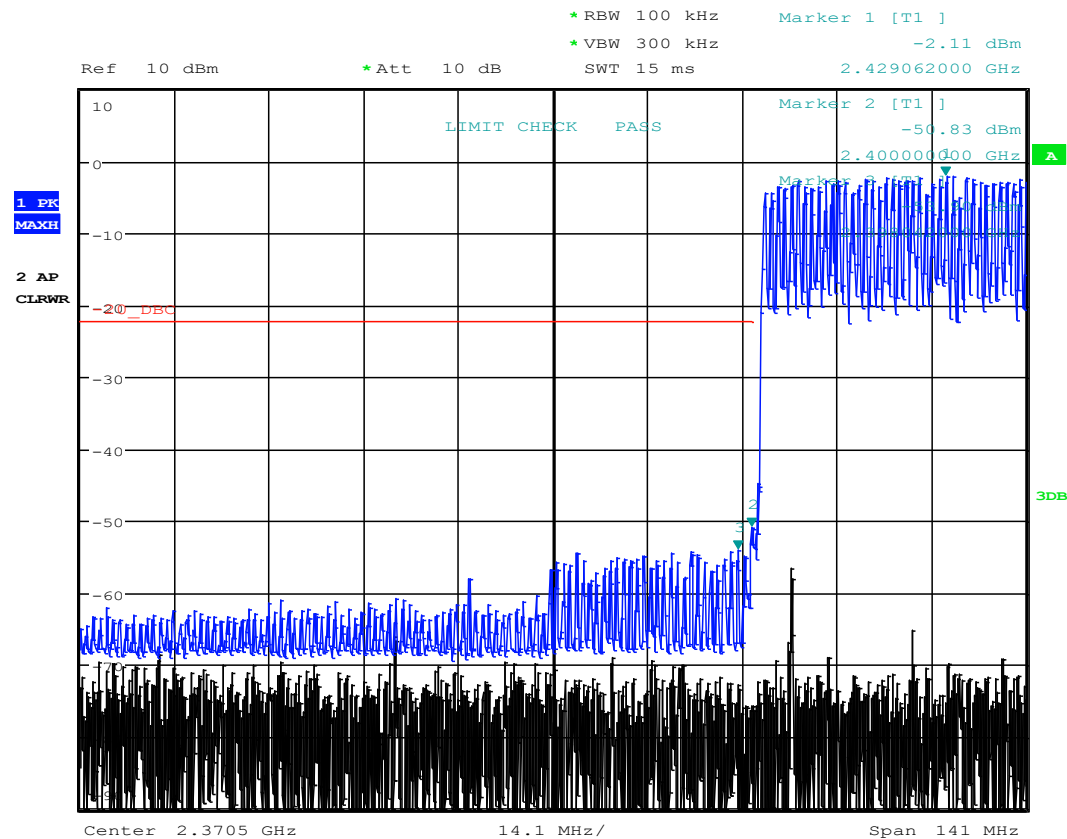
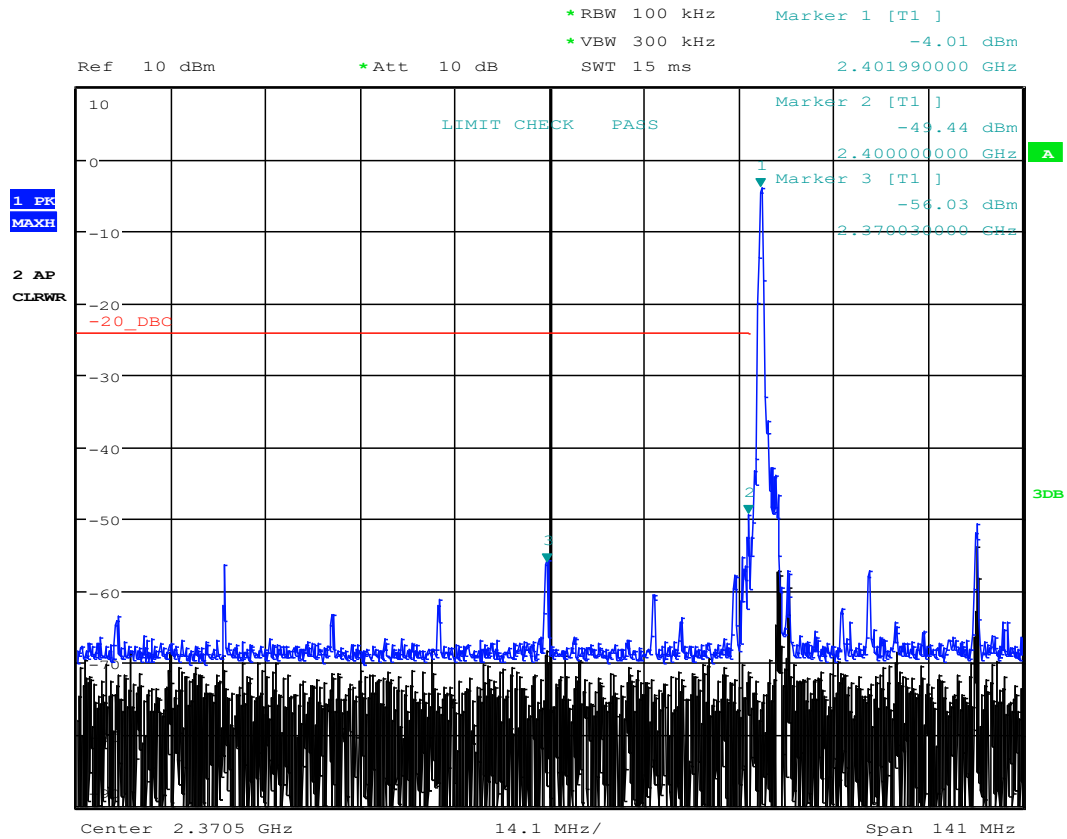


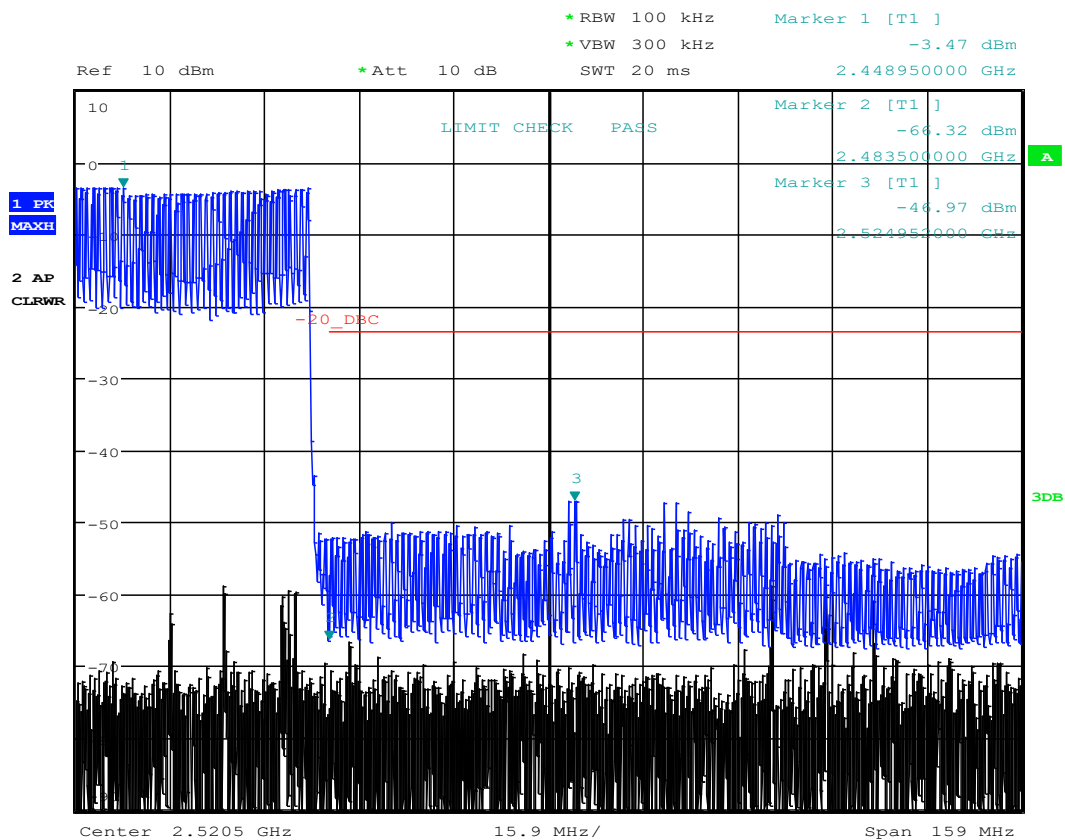
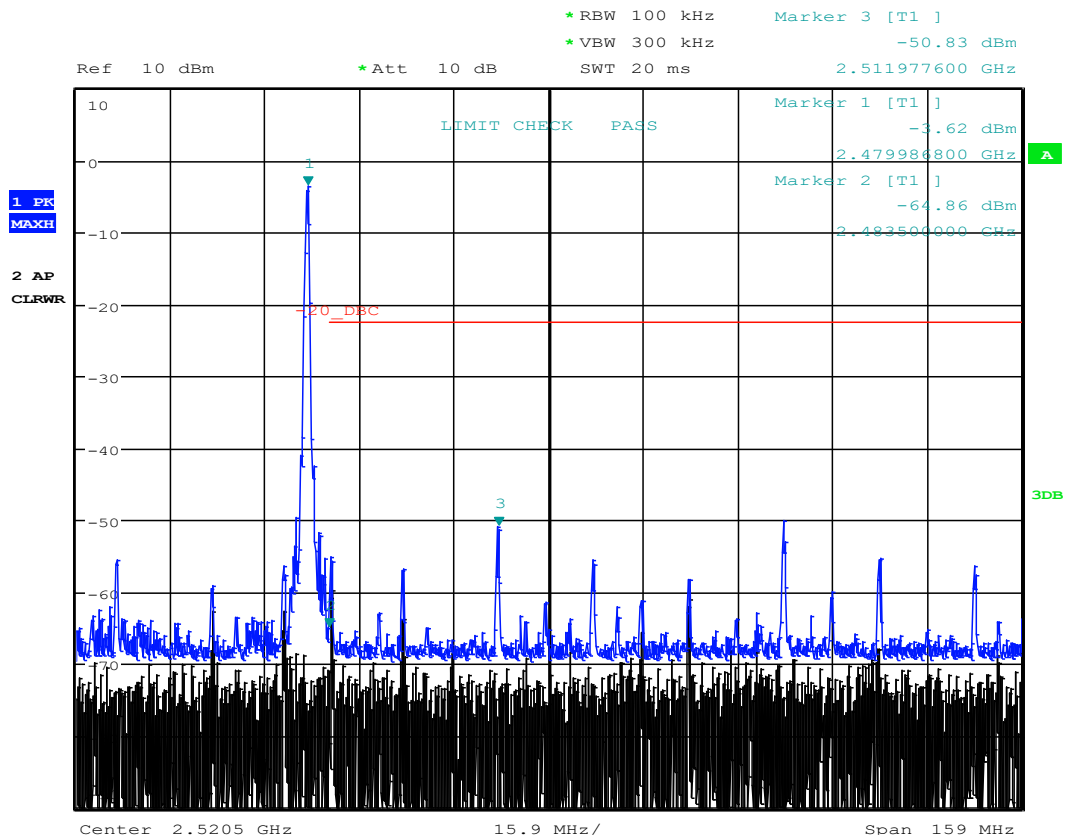
BDR DH5



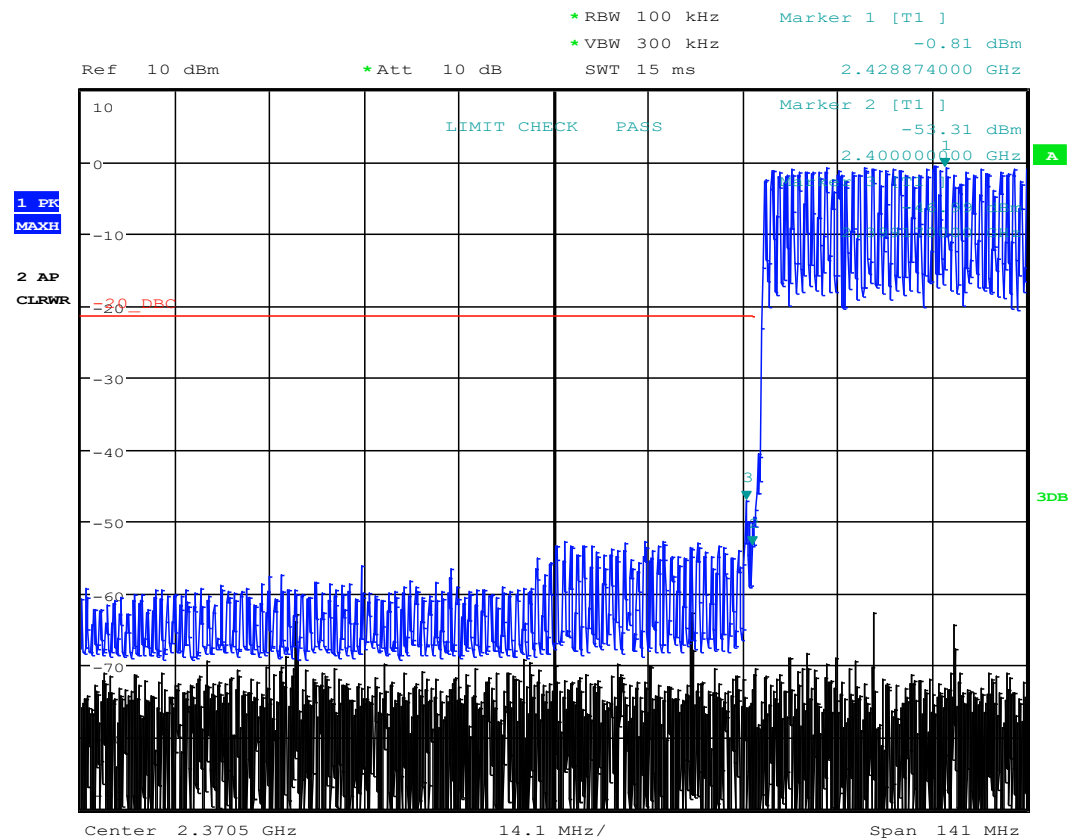
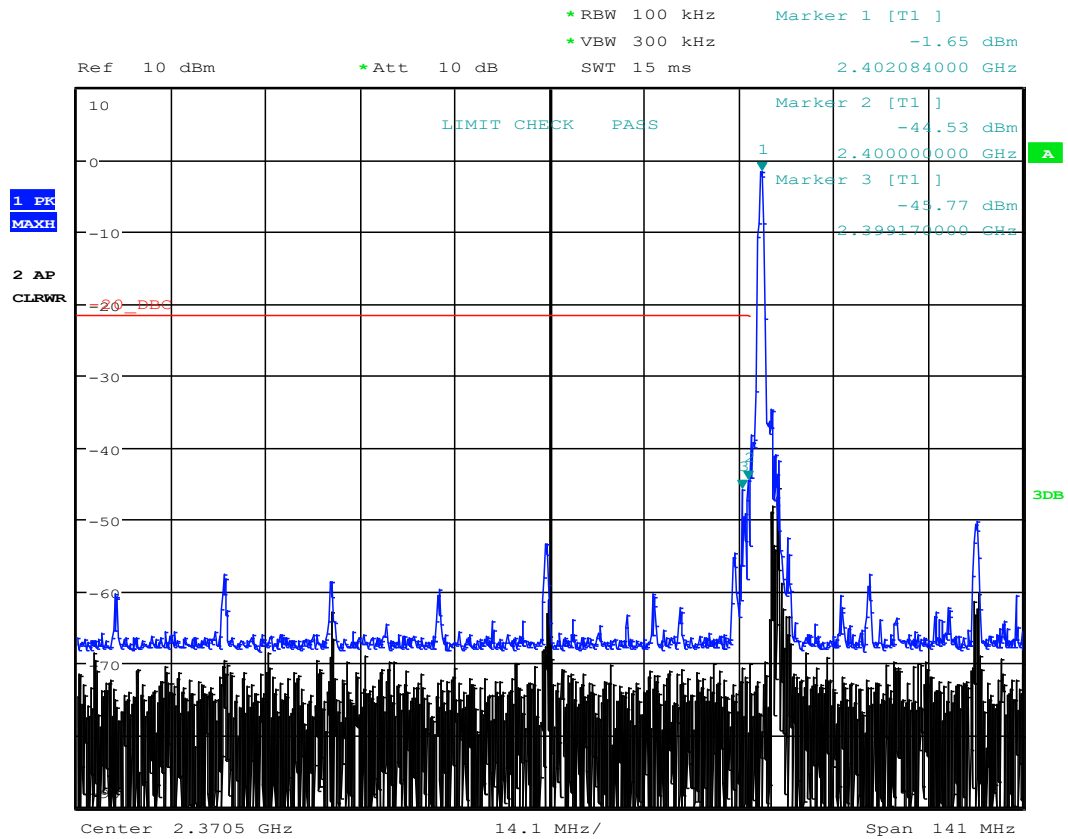


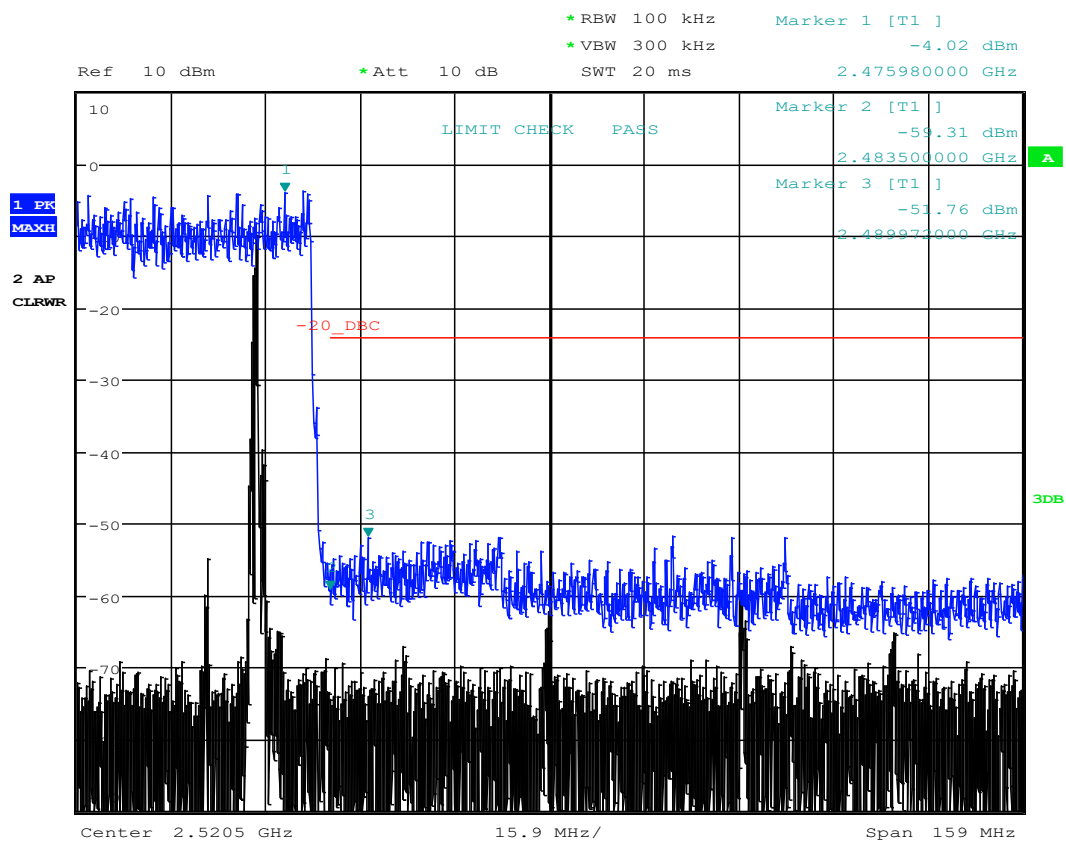
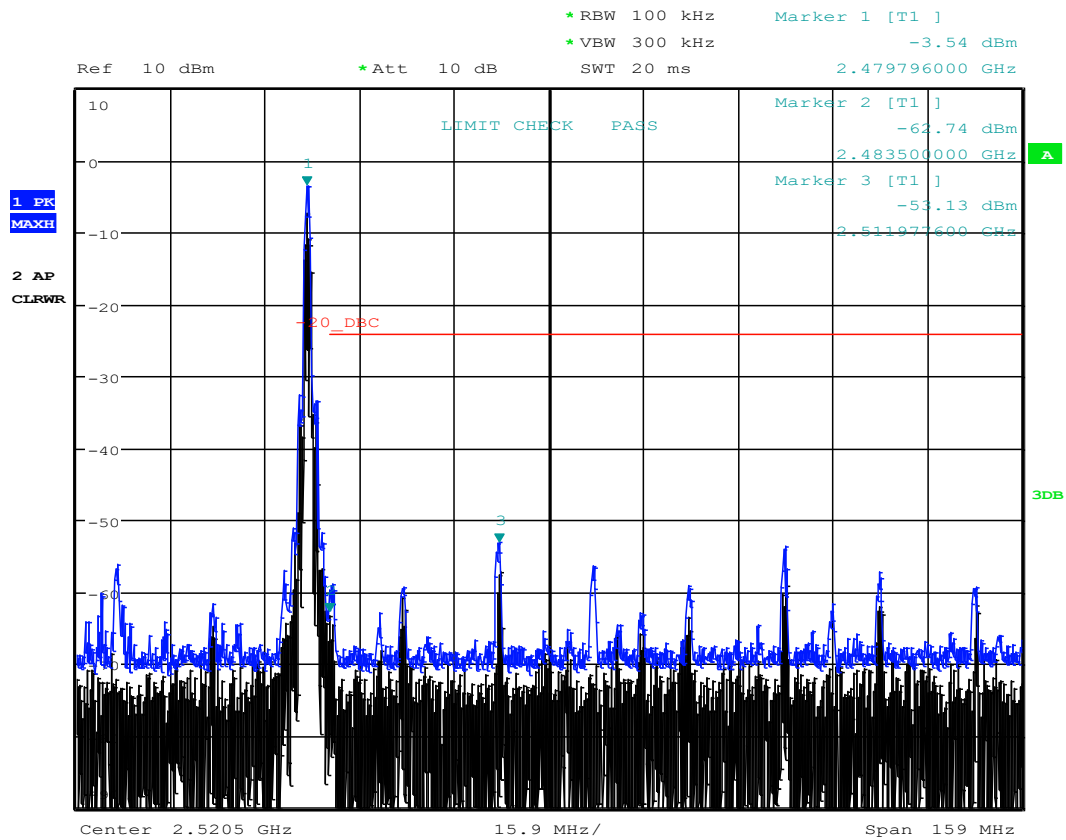
EDR DM1



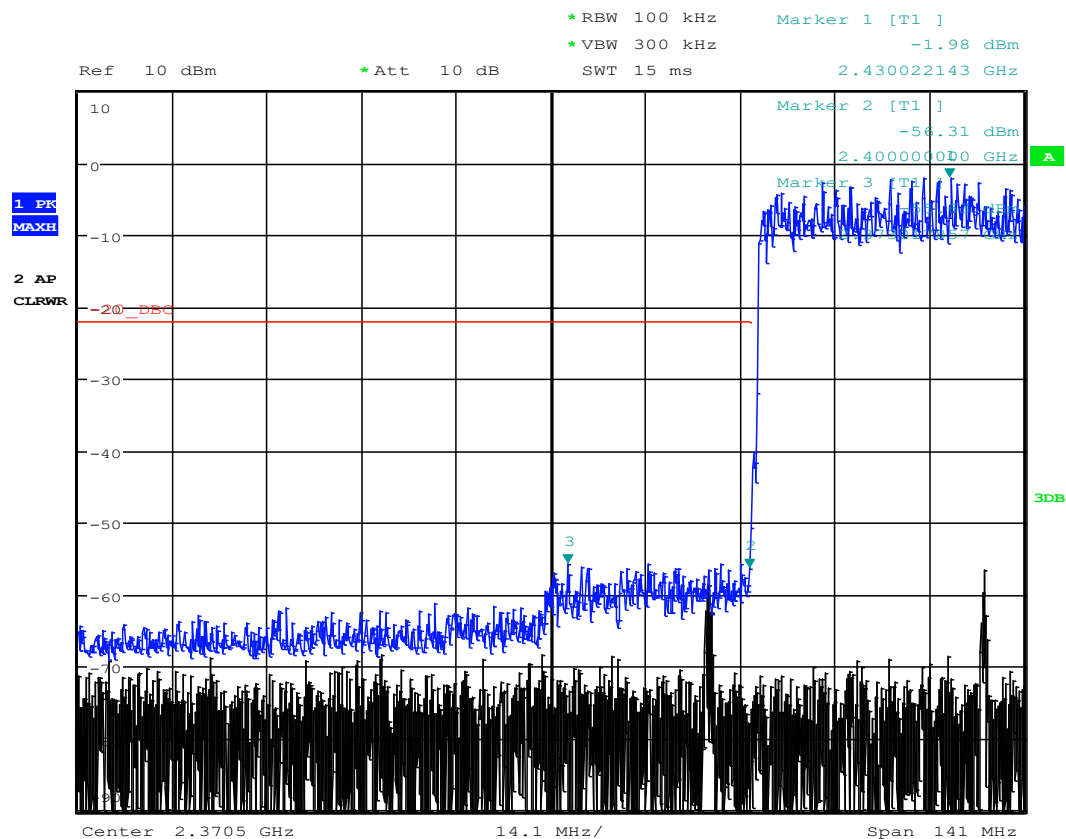
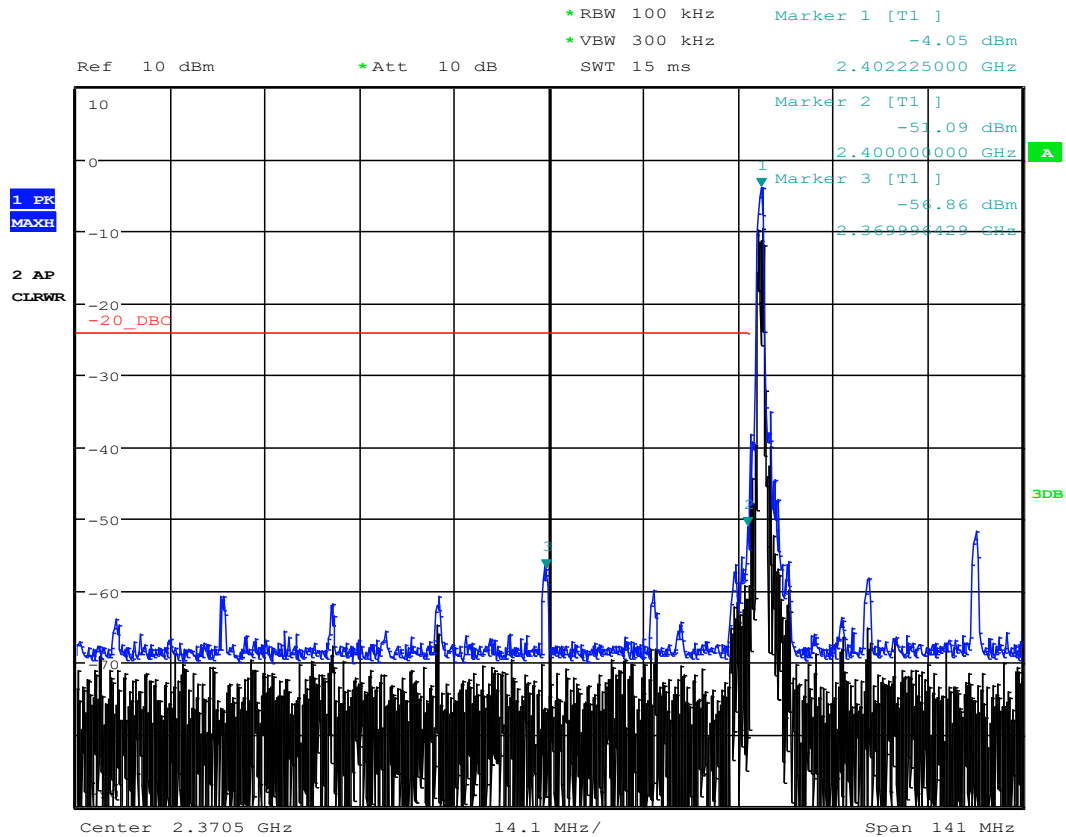


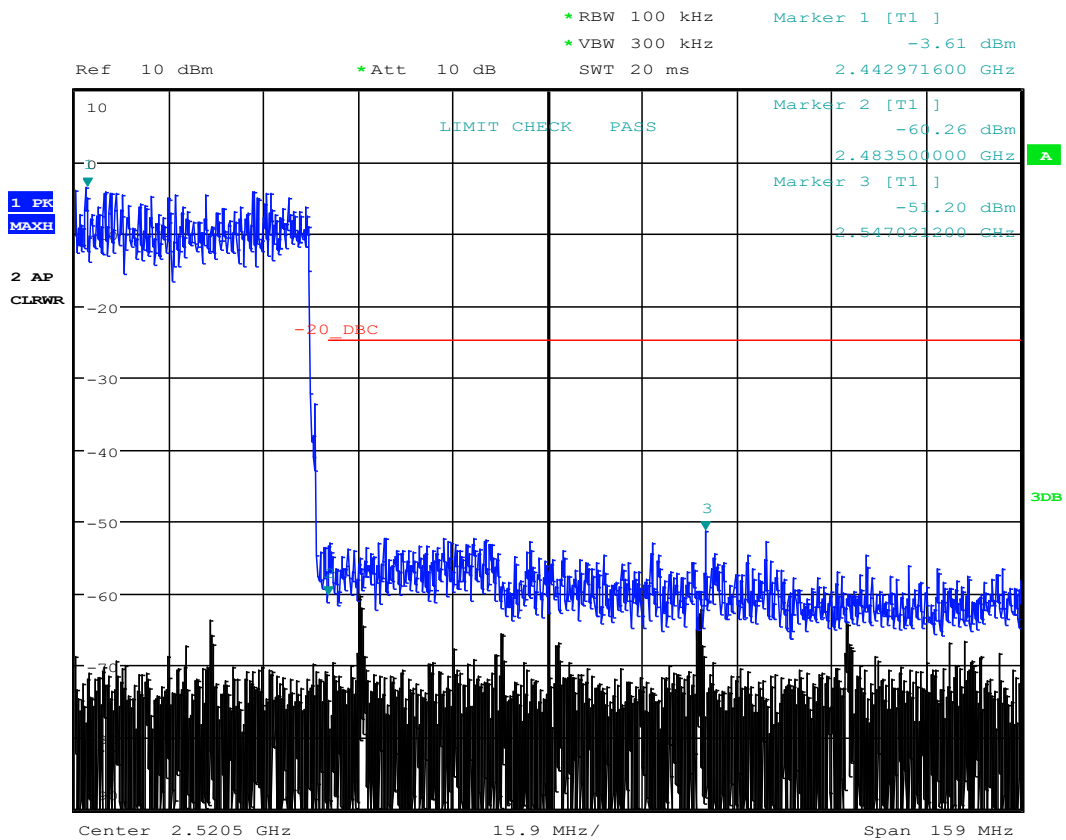
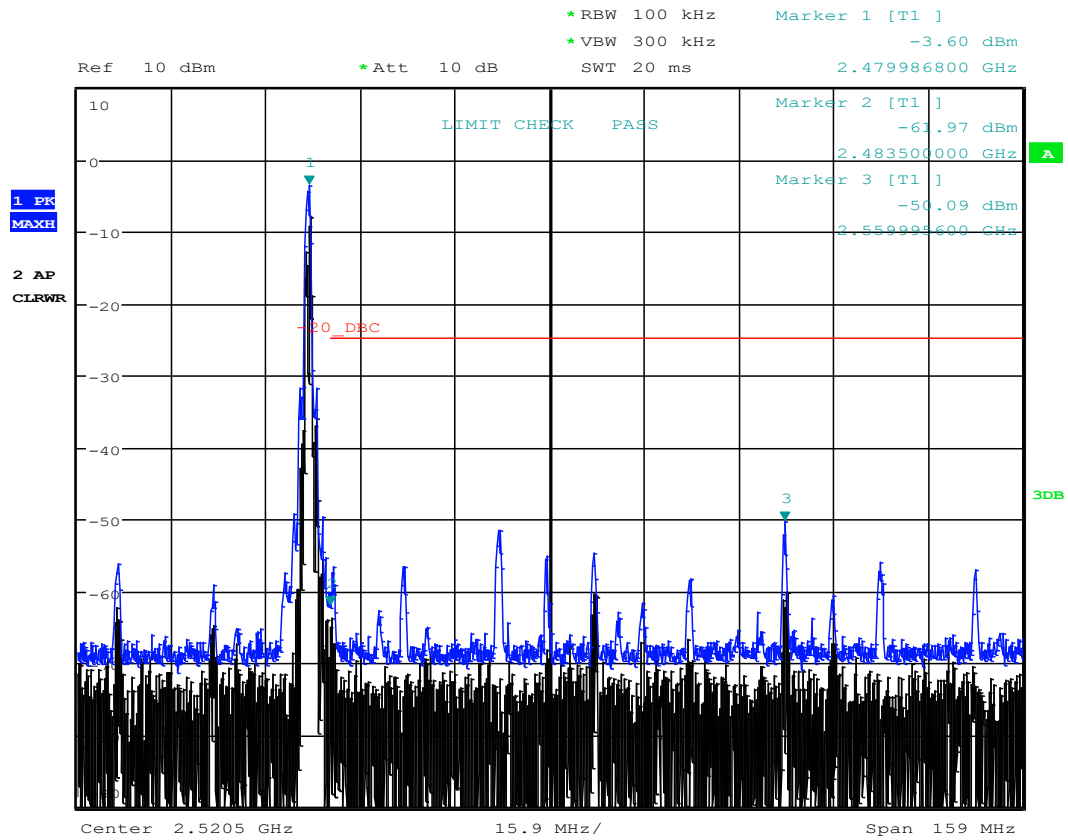
EDR 2-DH3



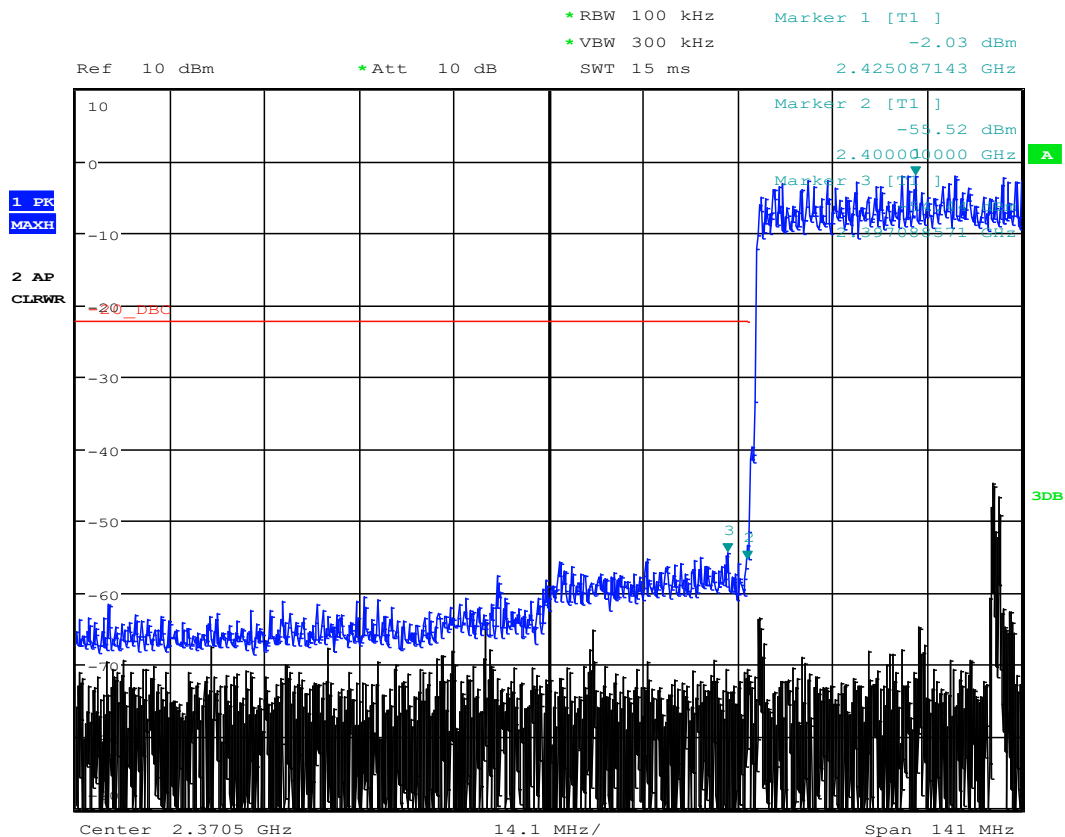
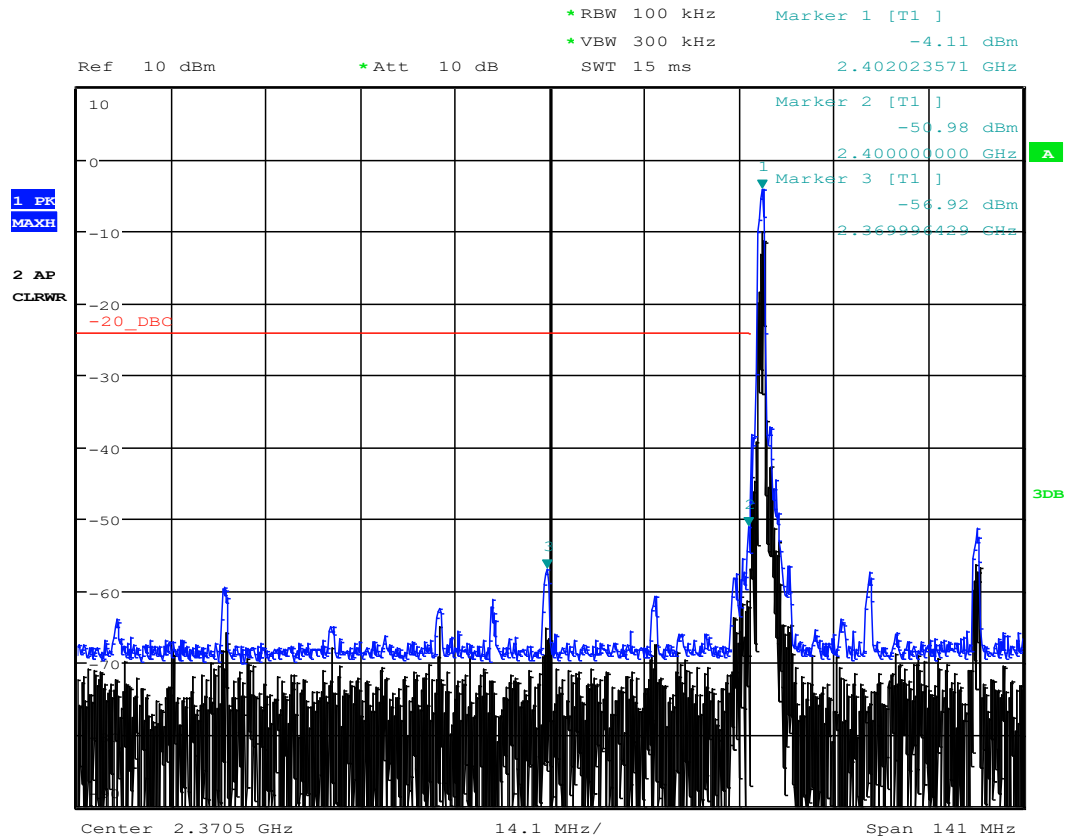


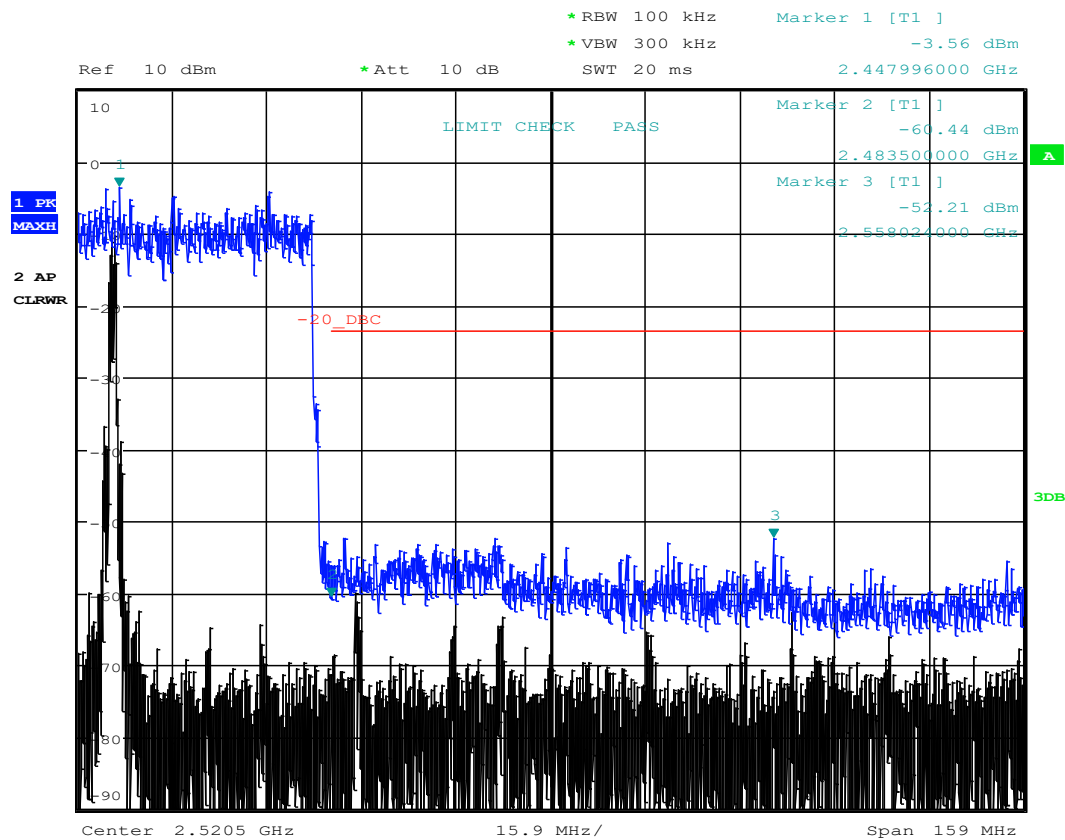
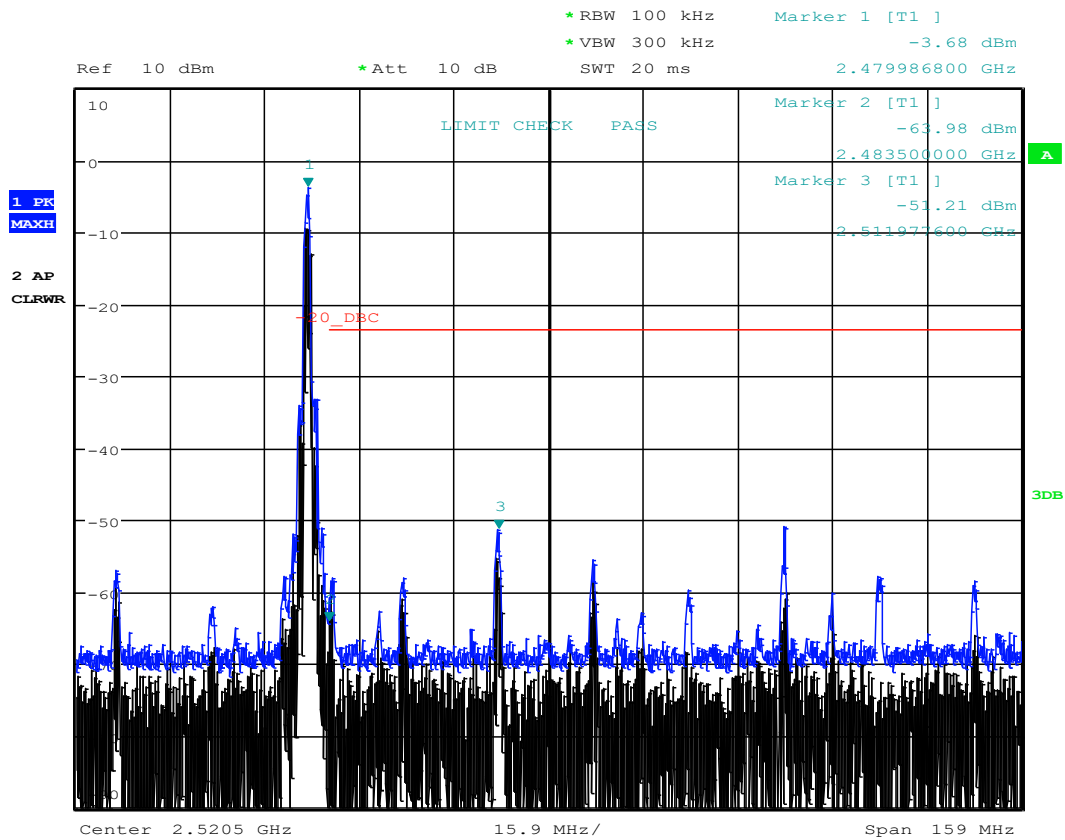
EDR 3-DH3



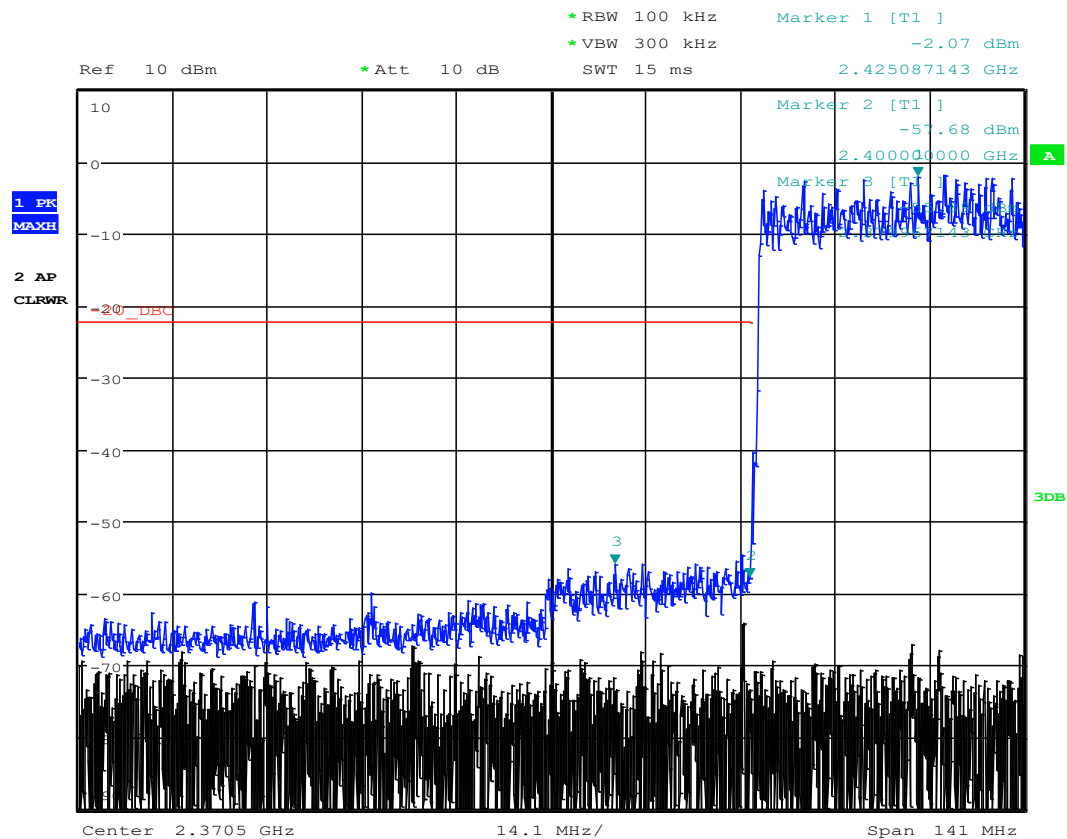
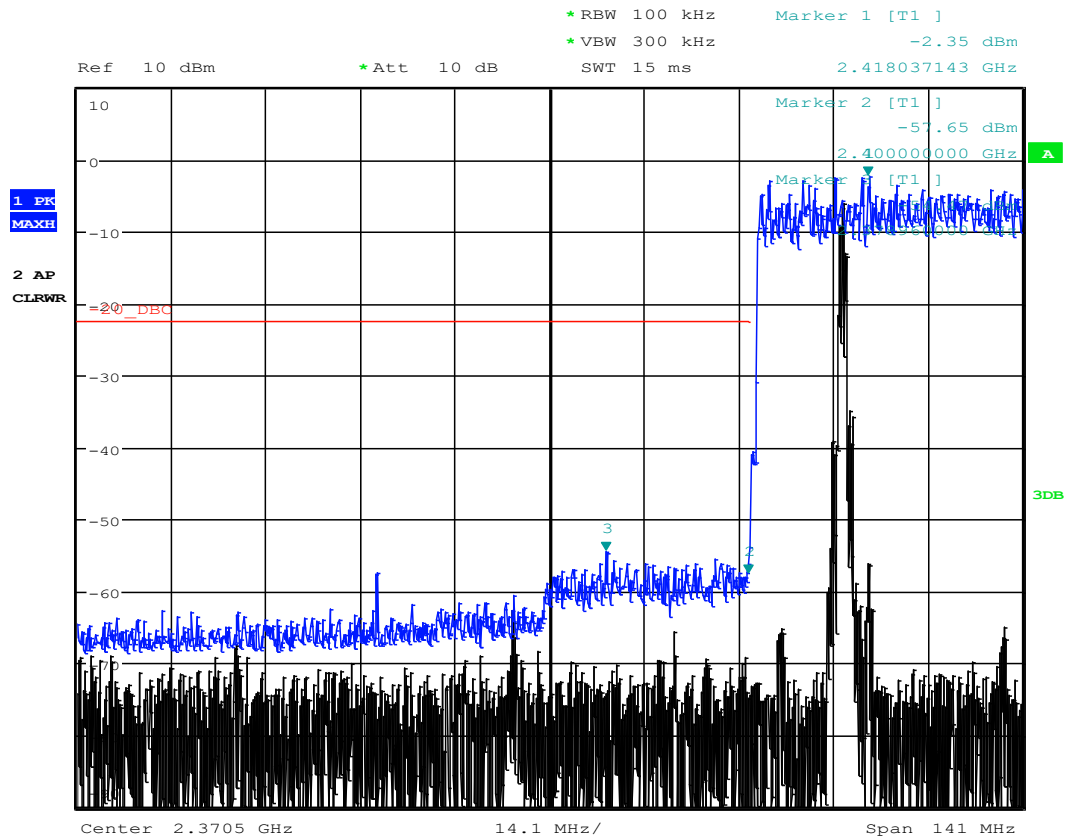


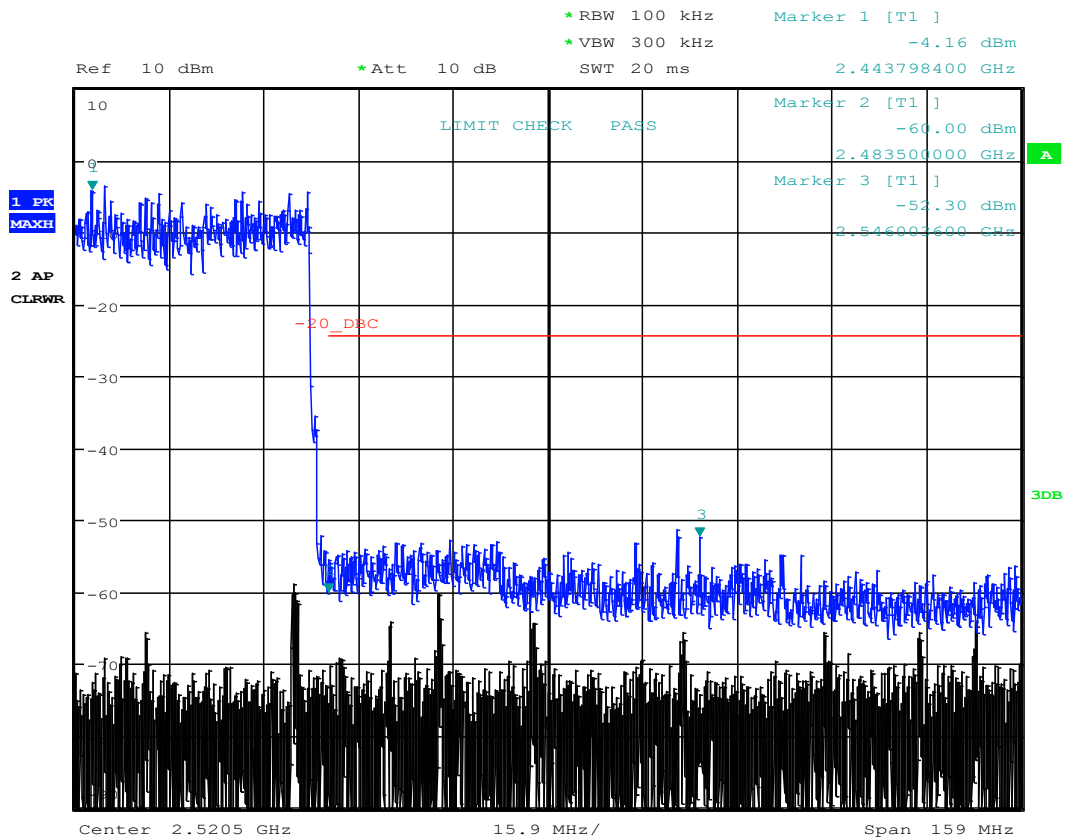
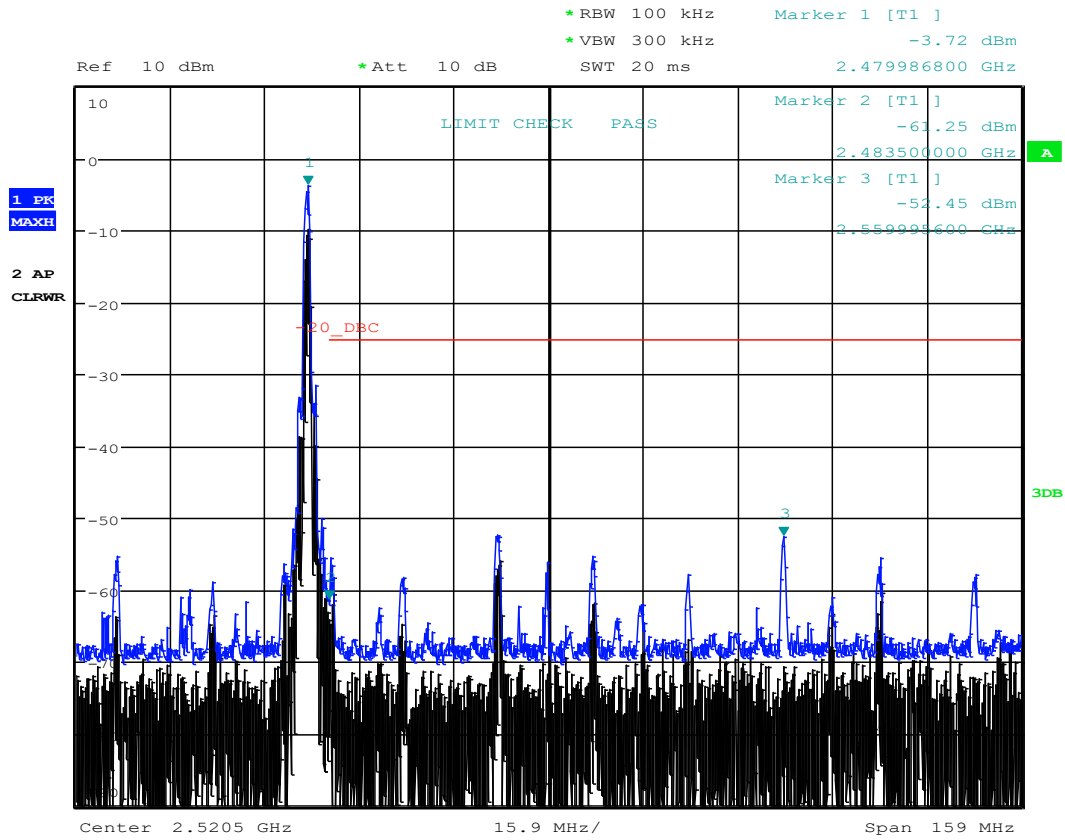
EDR 2-DH5





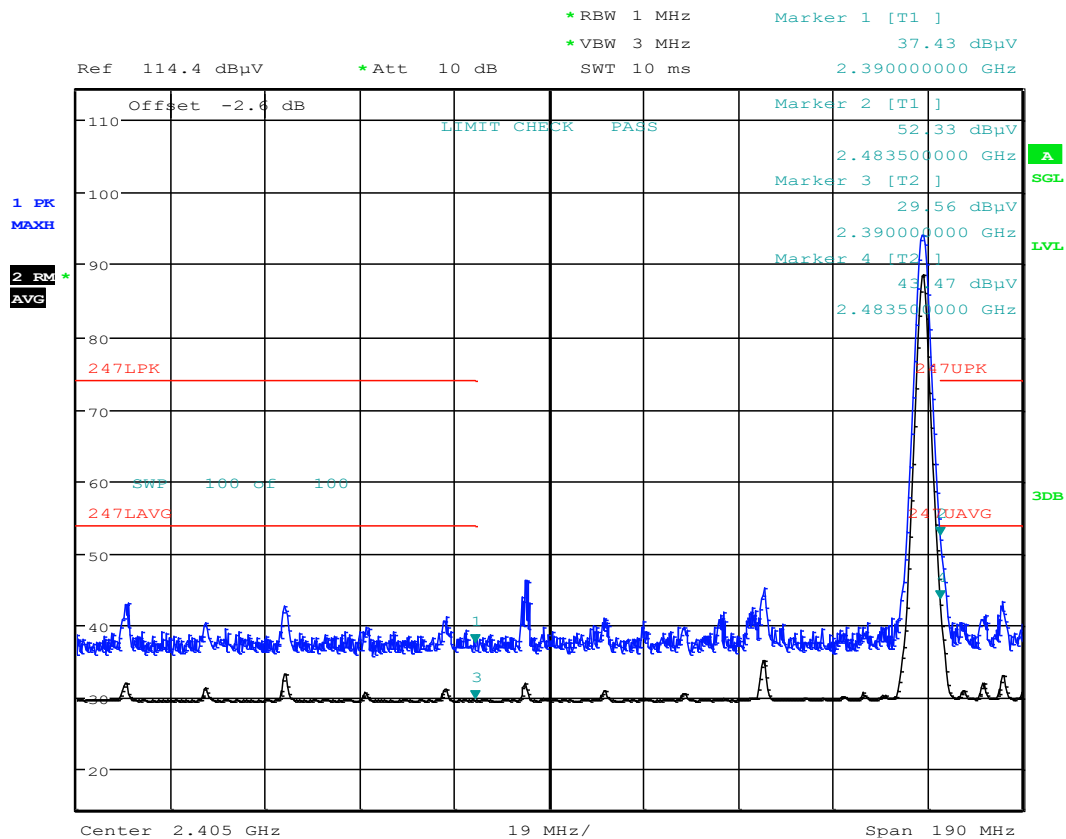
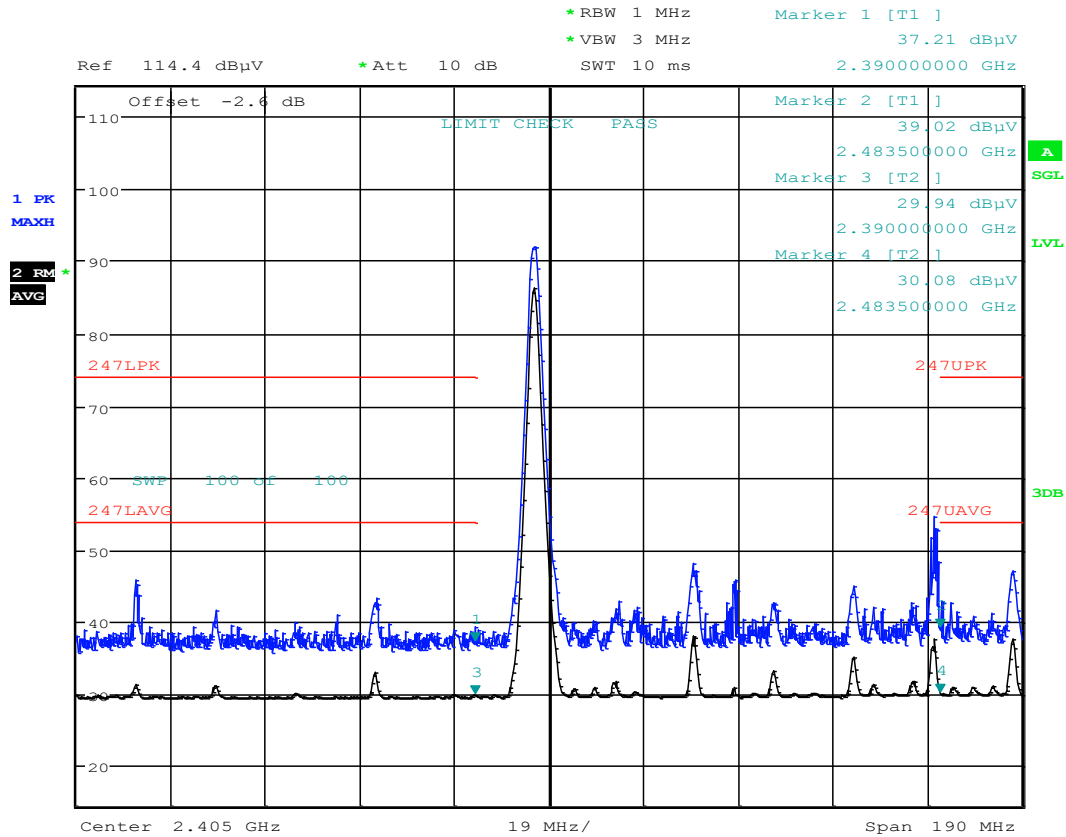
EDR 3-DH5

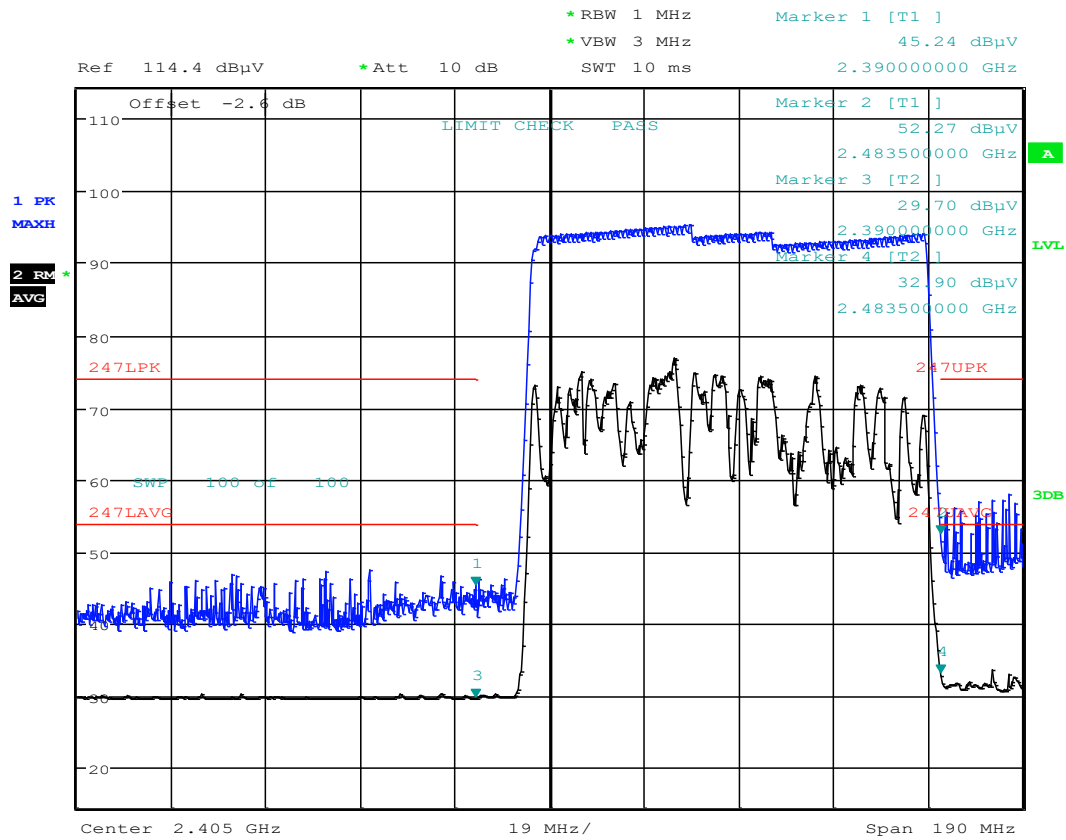




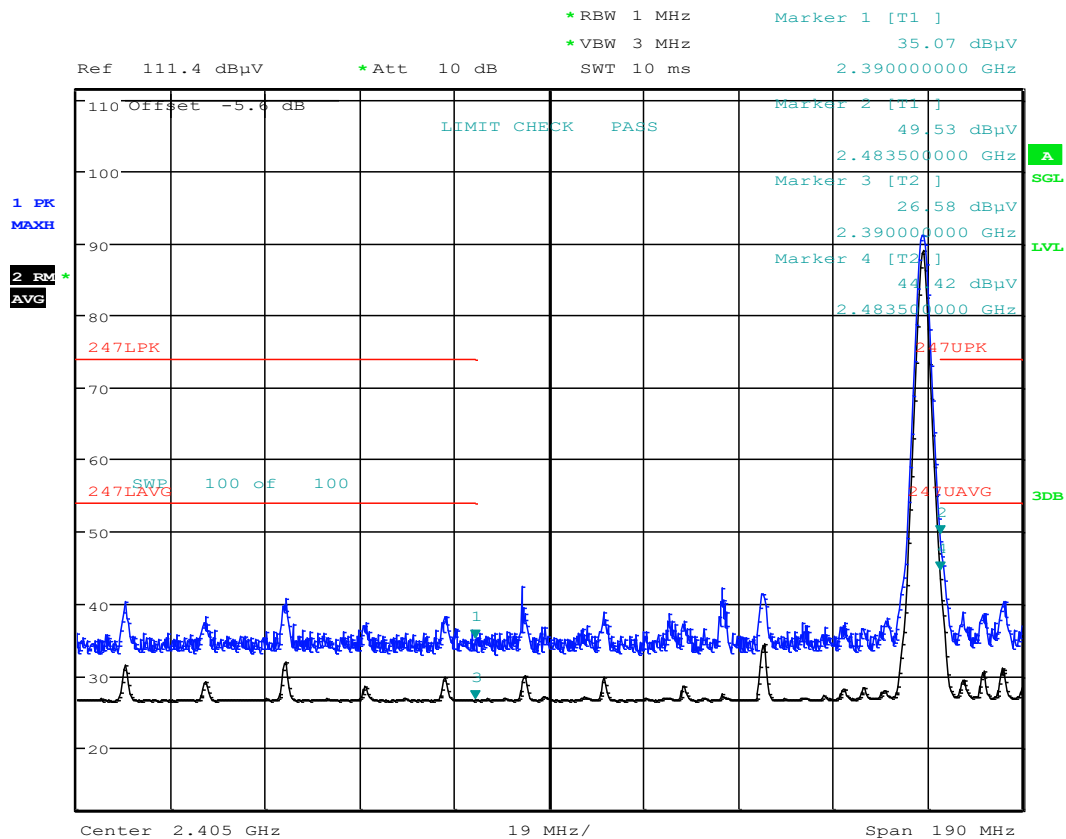
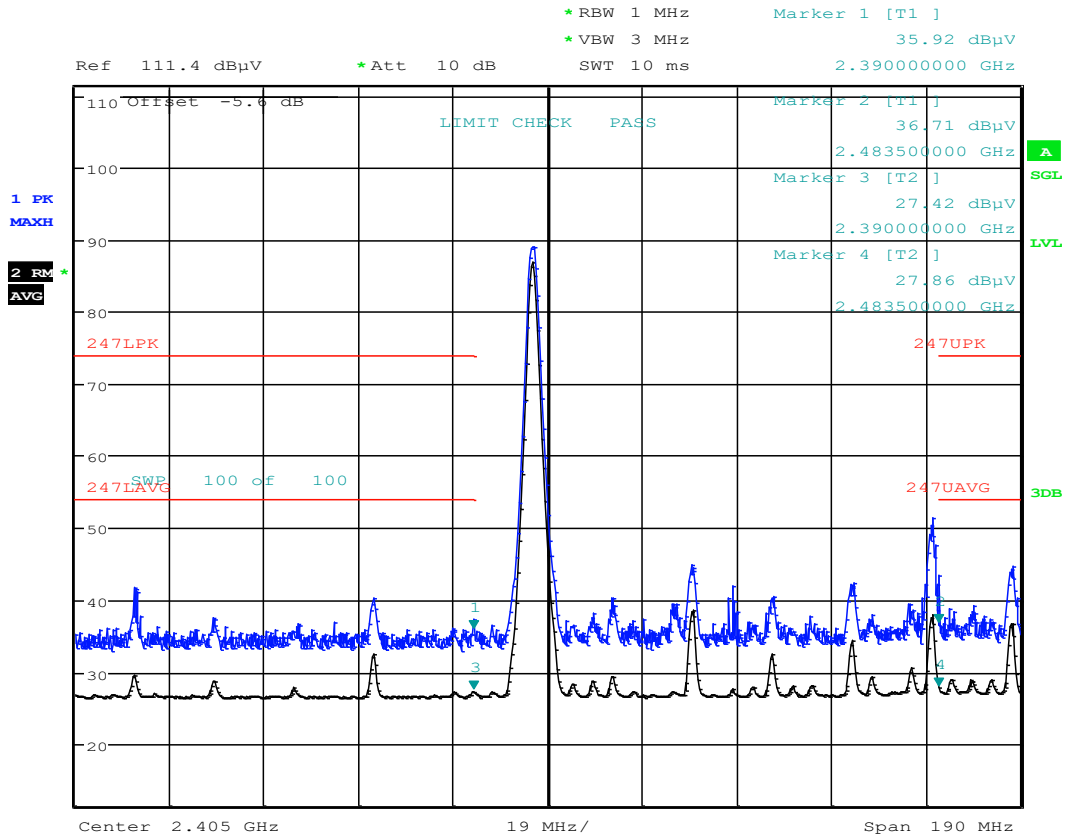
Restricted-Band Band-Edge Test Data

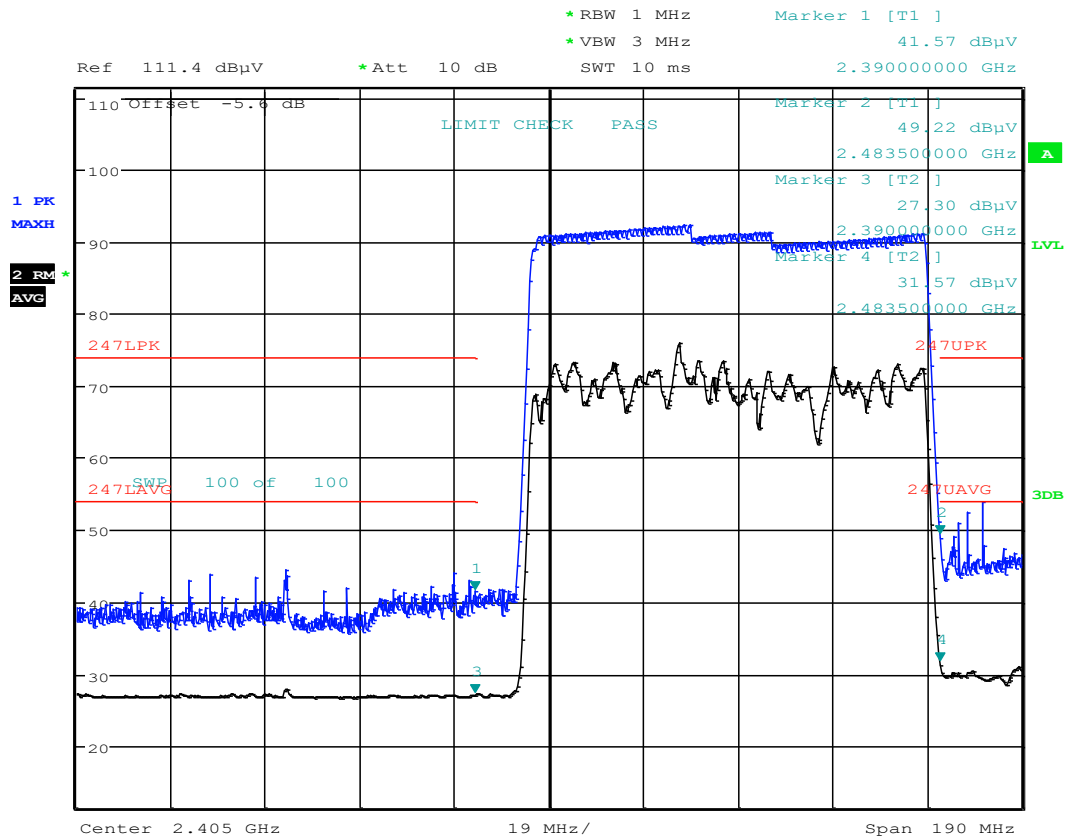
BDR DM1



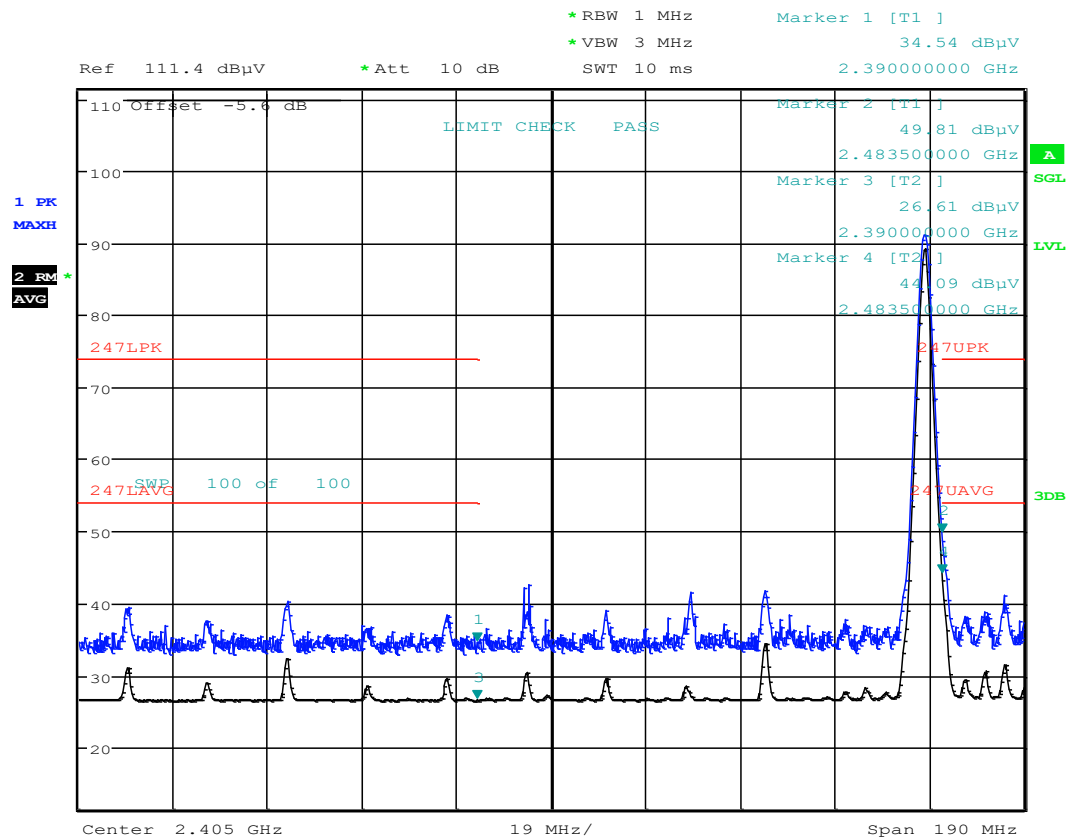
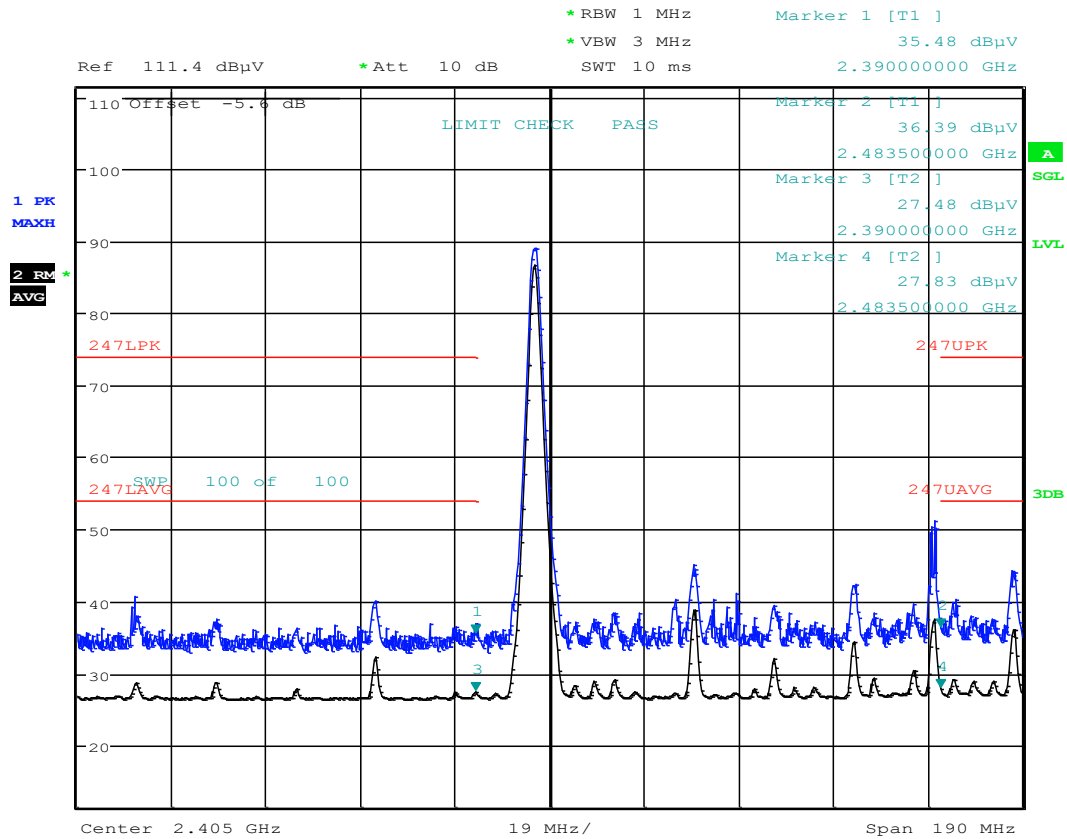


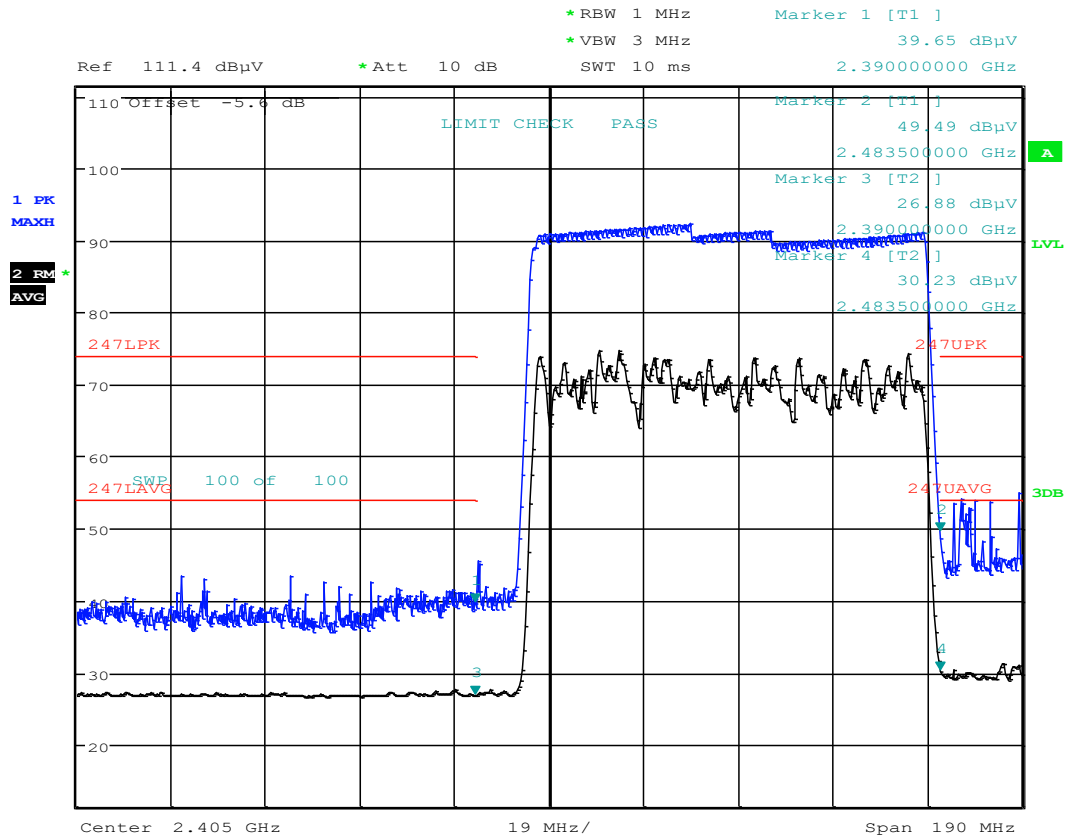
BDR DM3



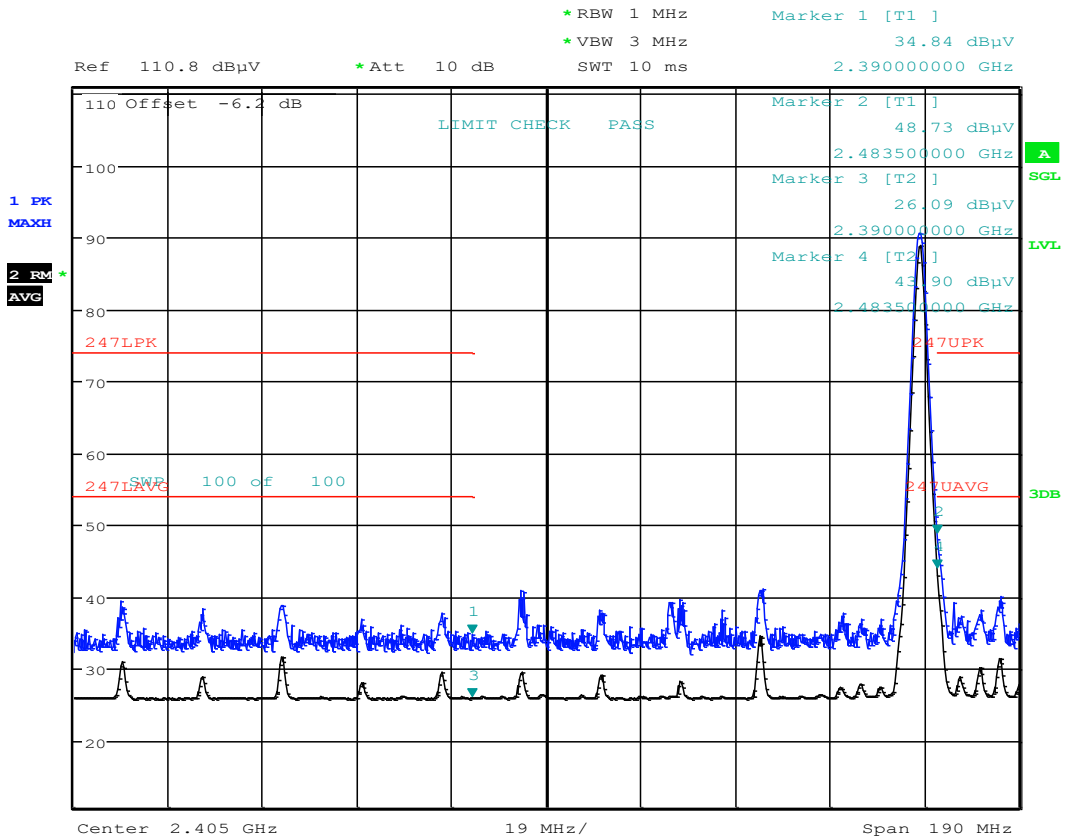
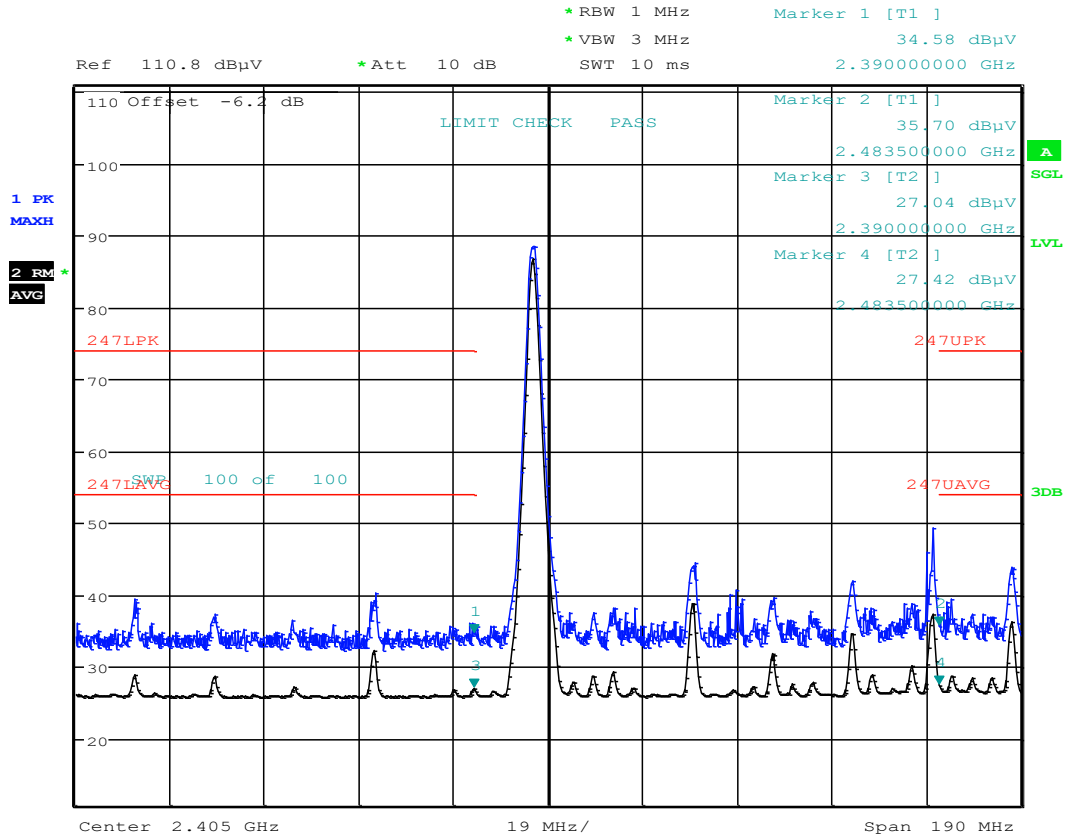


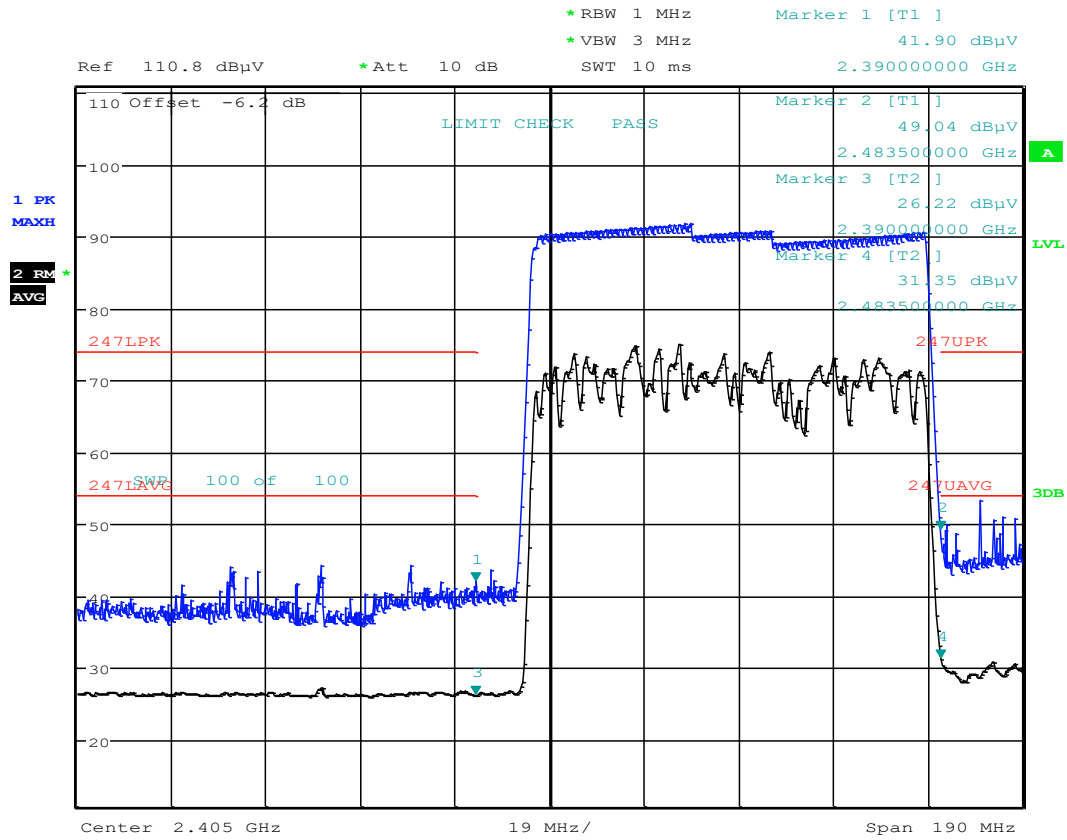
BDR DH3



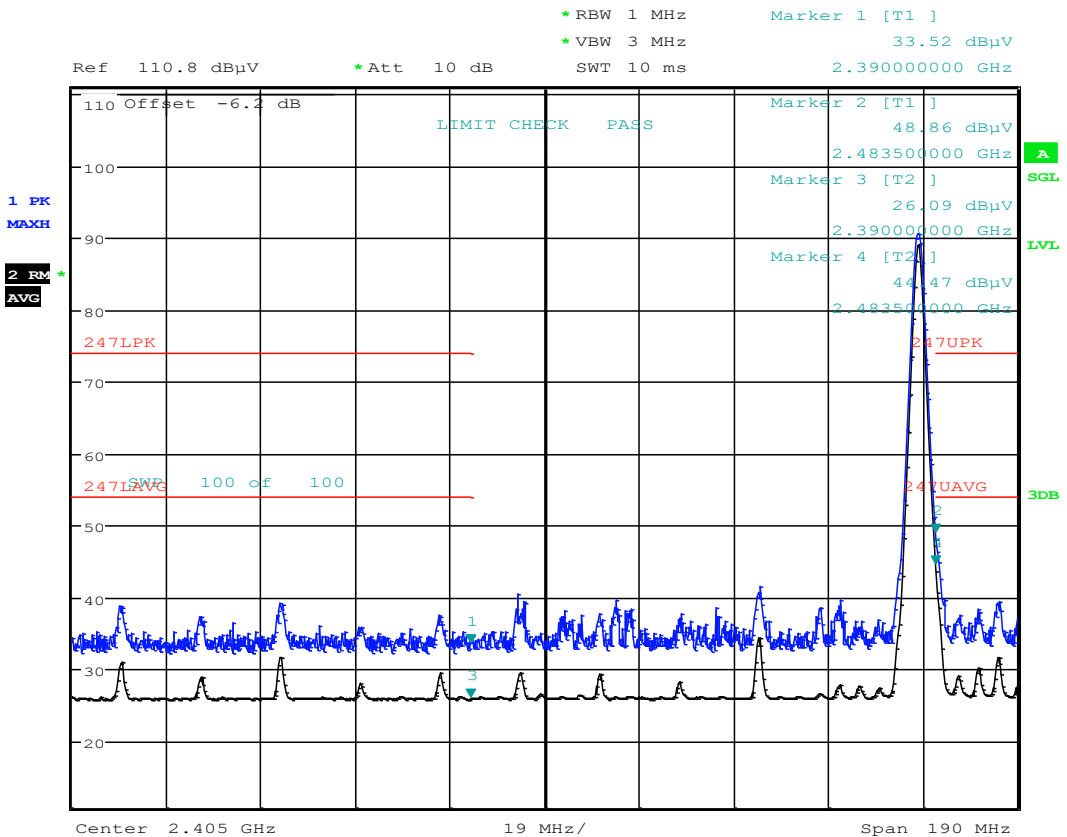
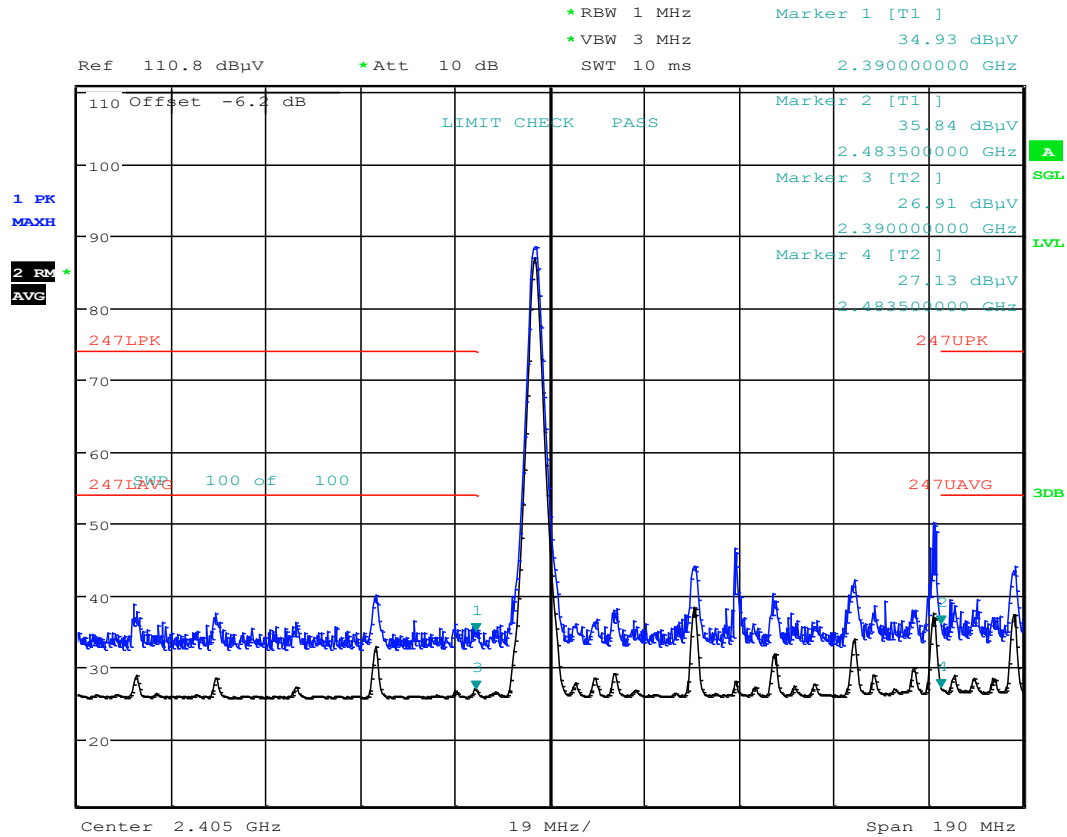


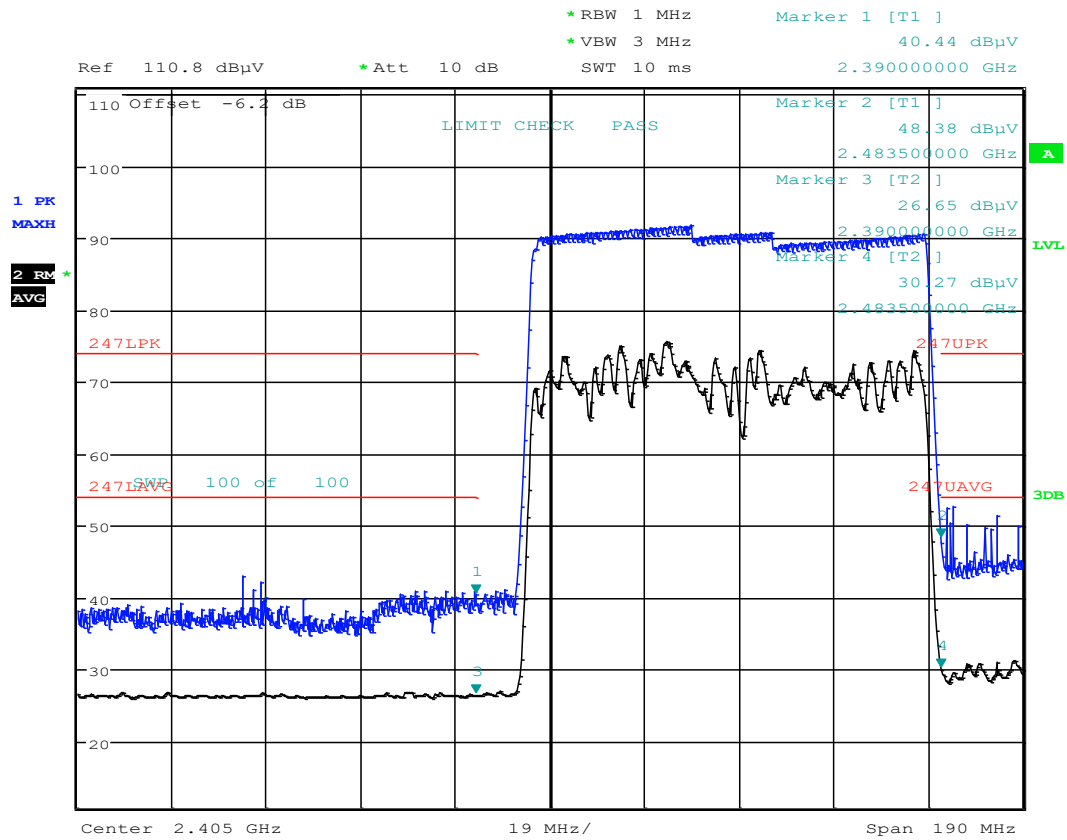
BDR DM5



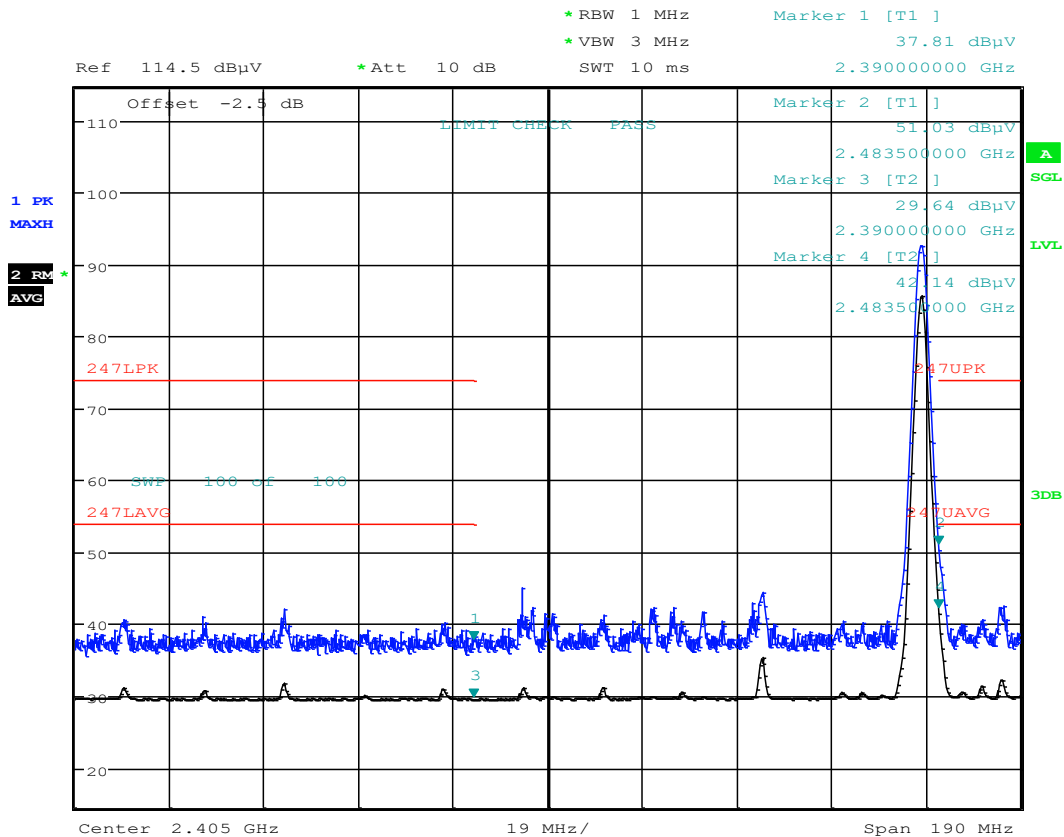
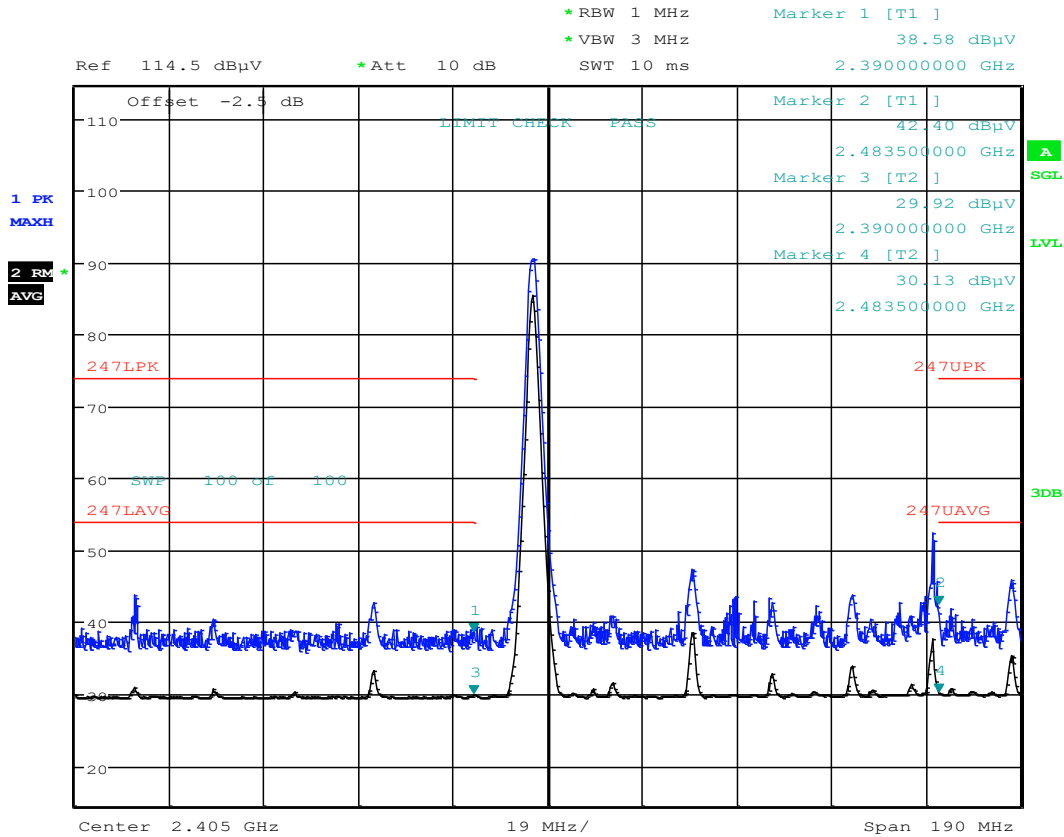


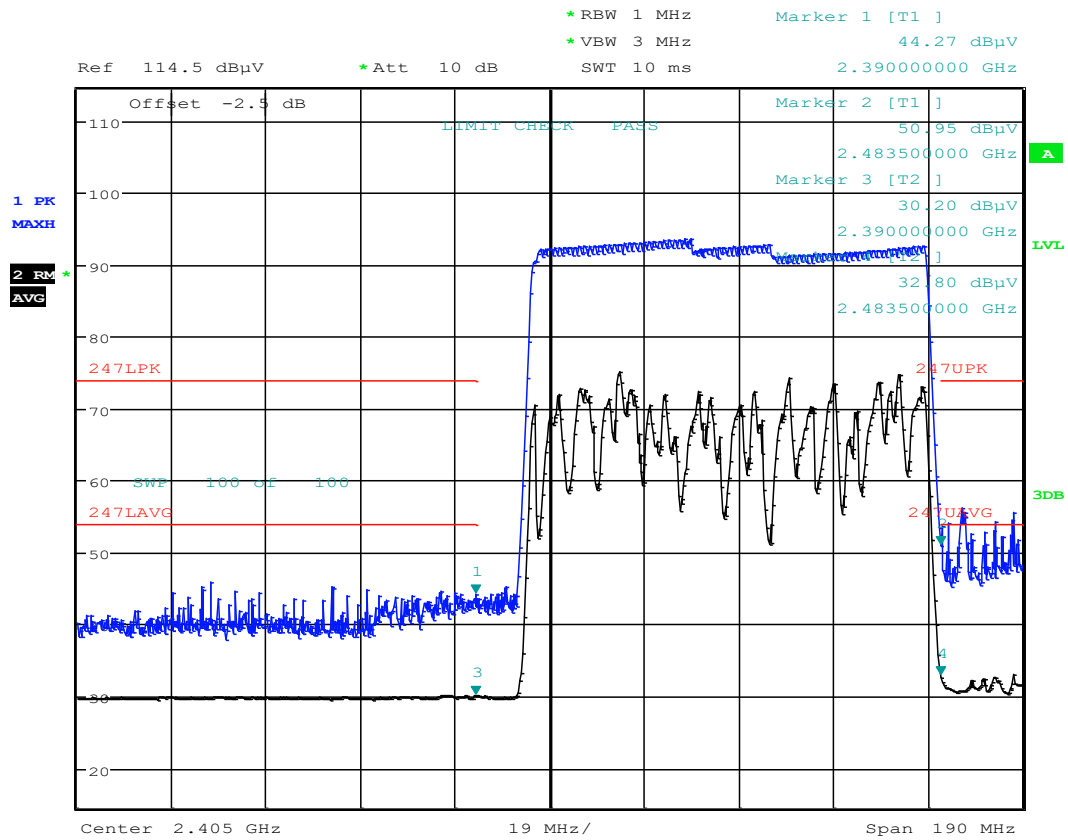
BDR DH5



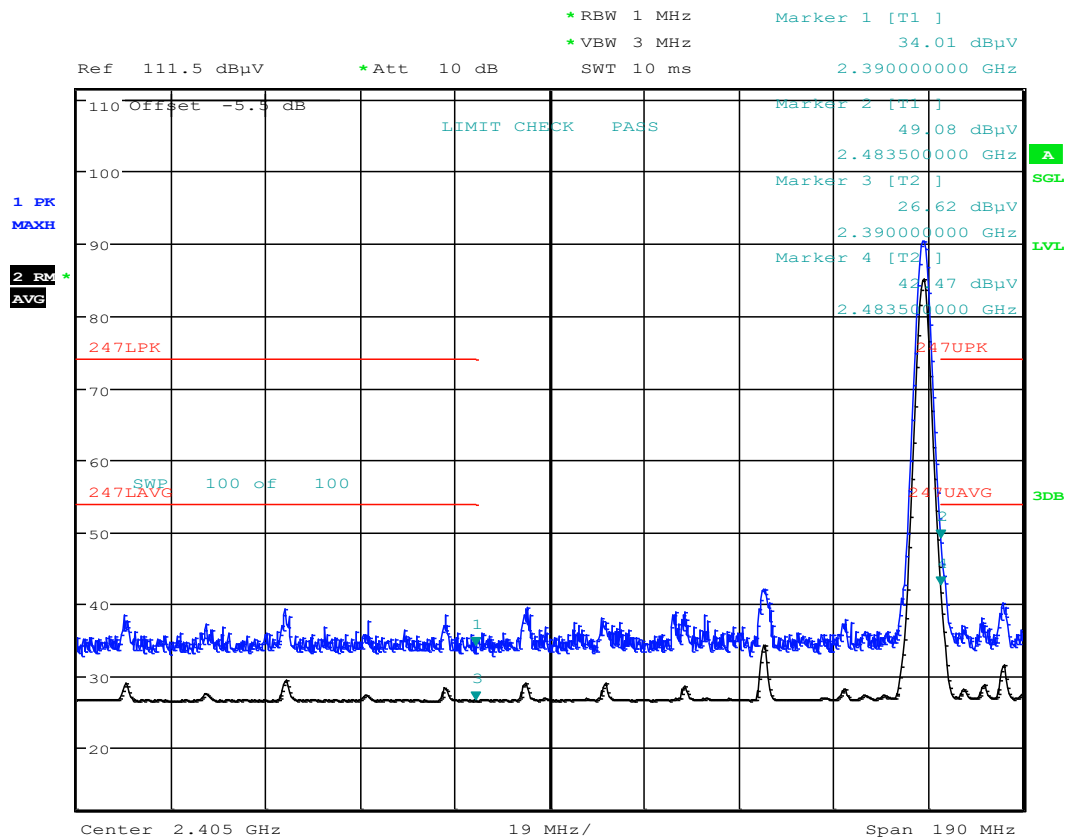
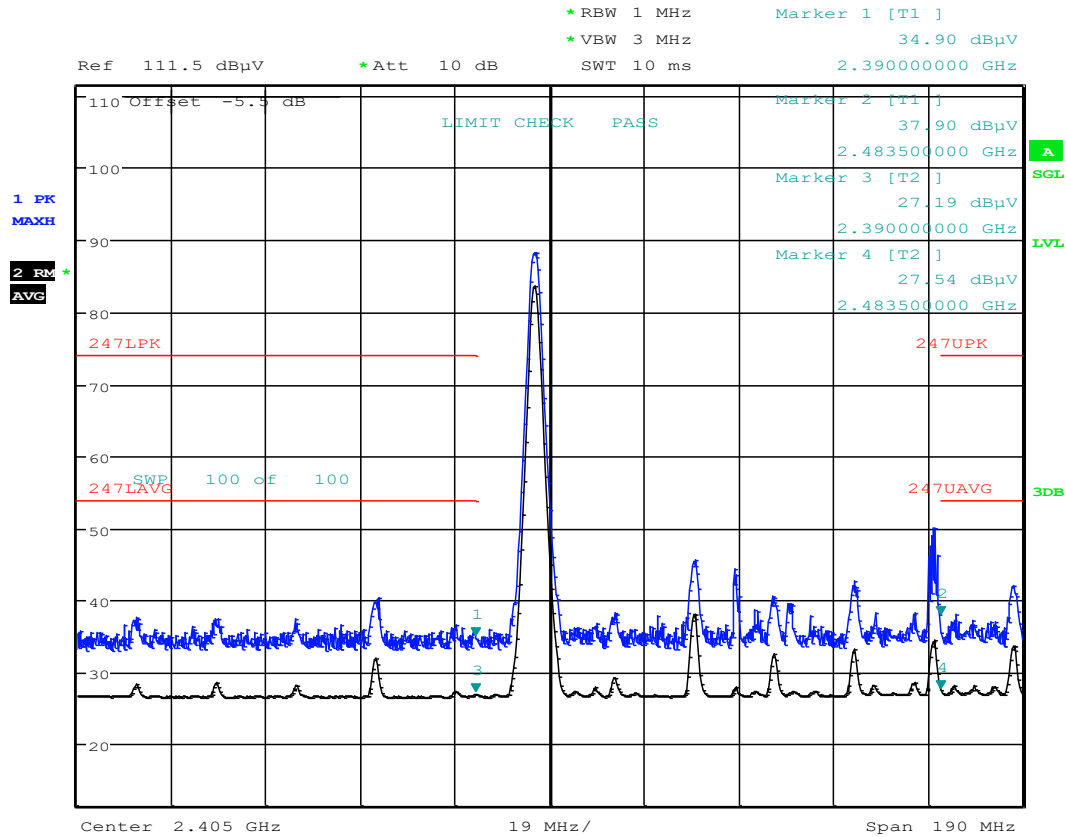


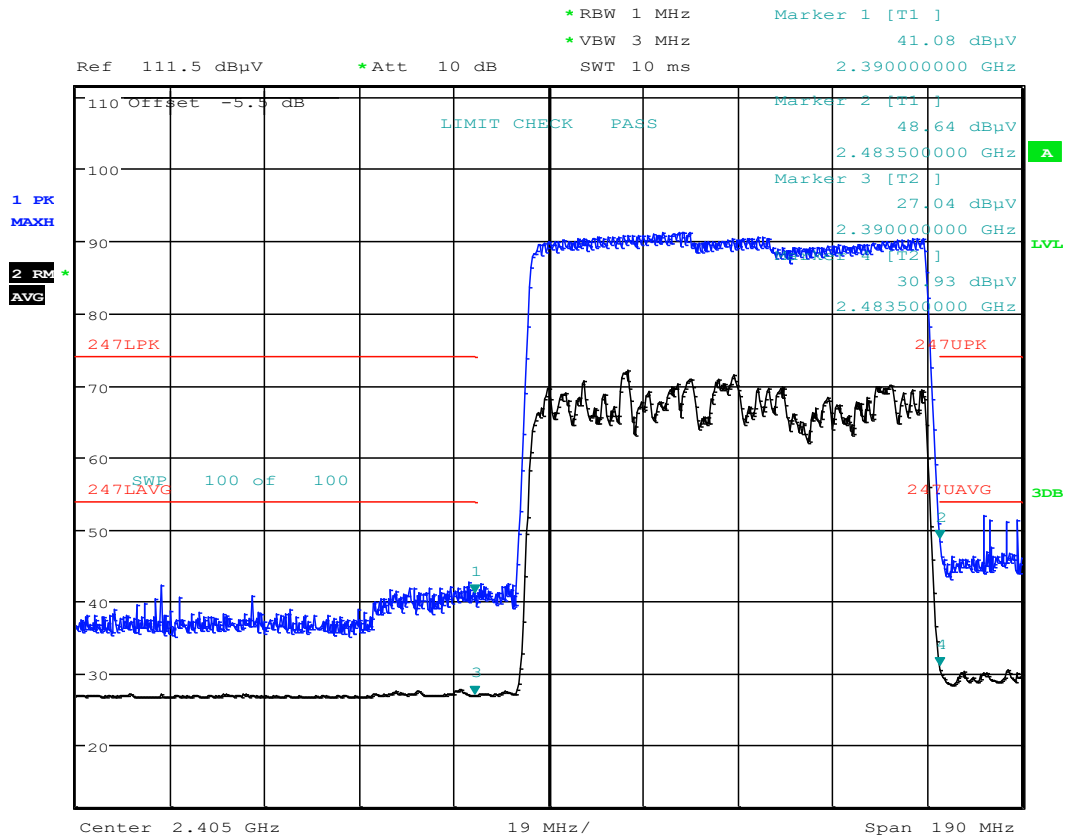
EDR DM1



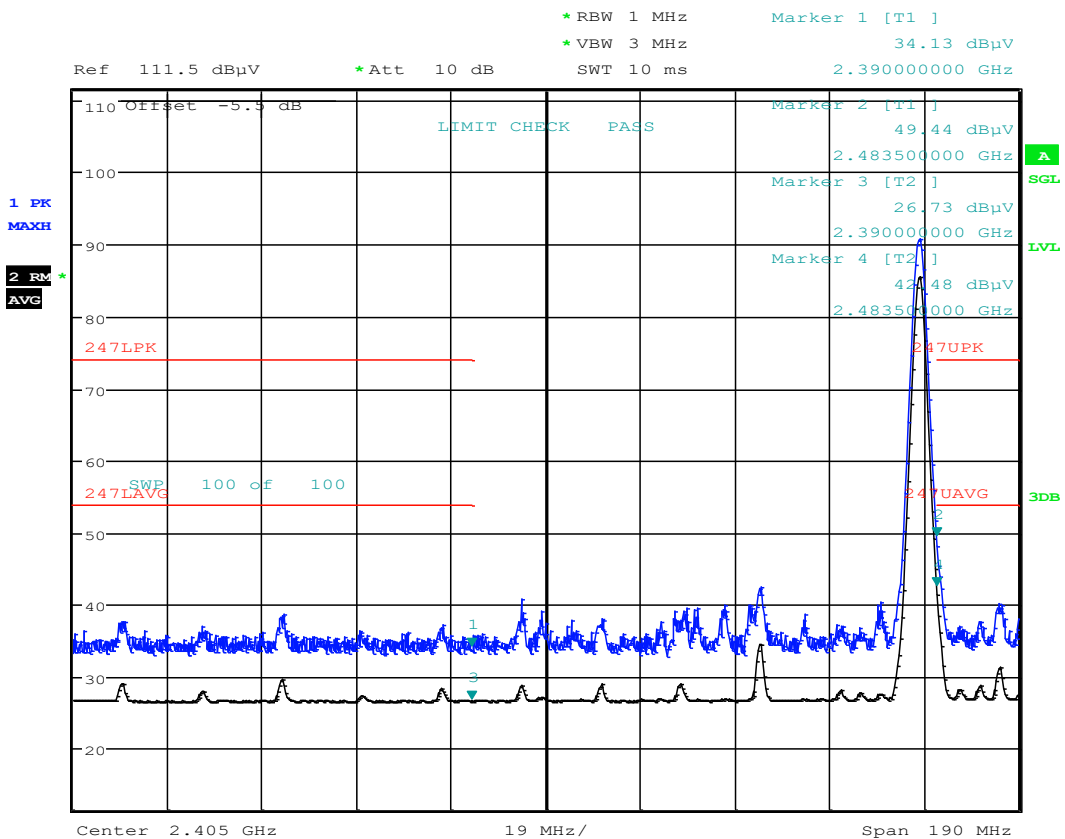
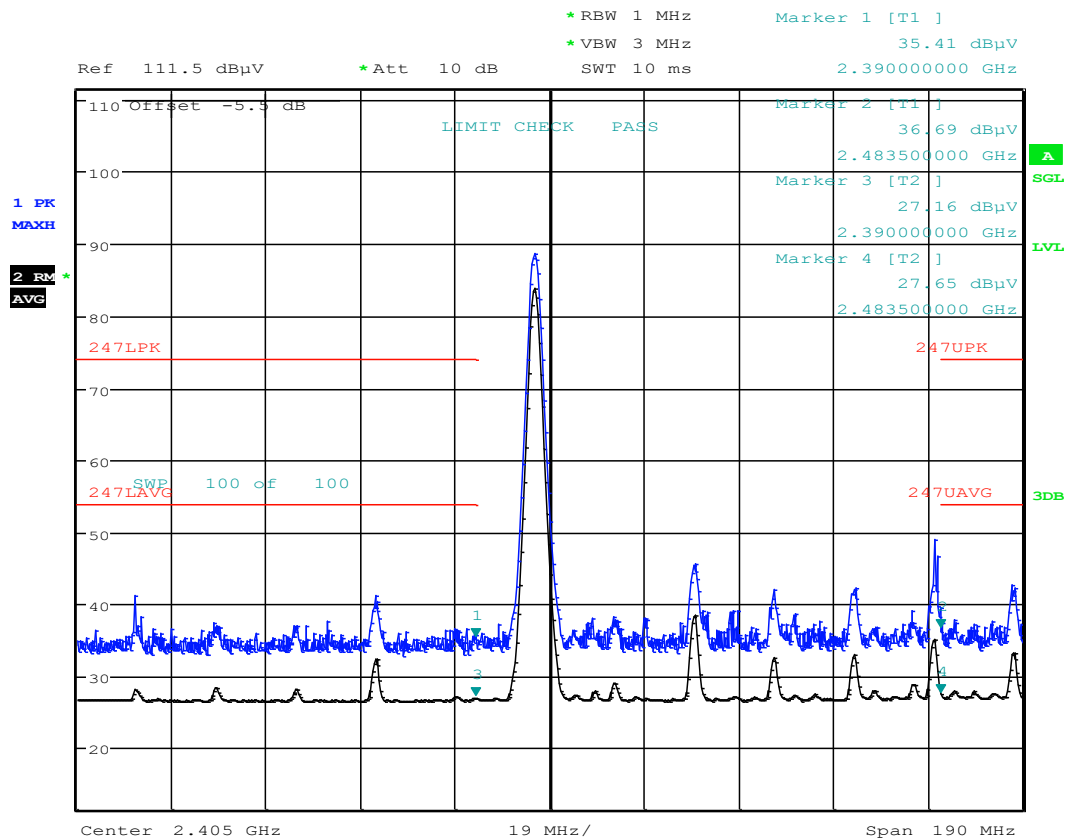


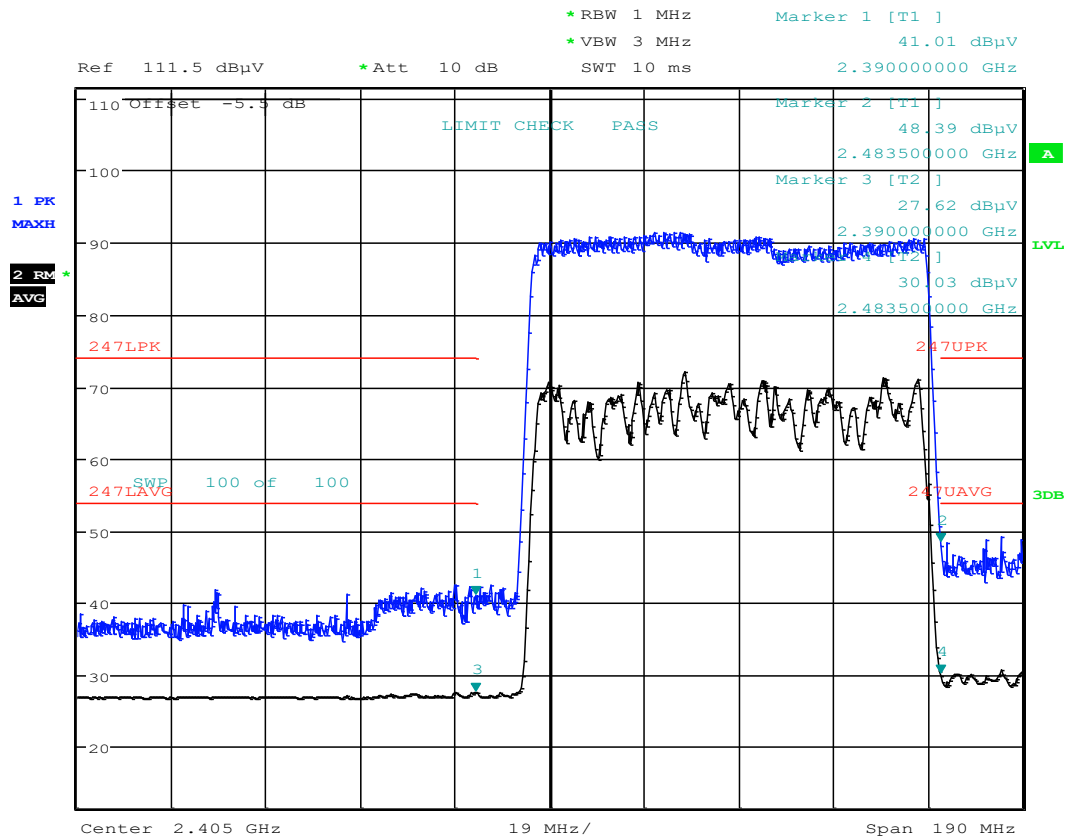
EDR 2-DH3



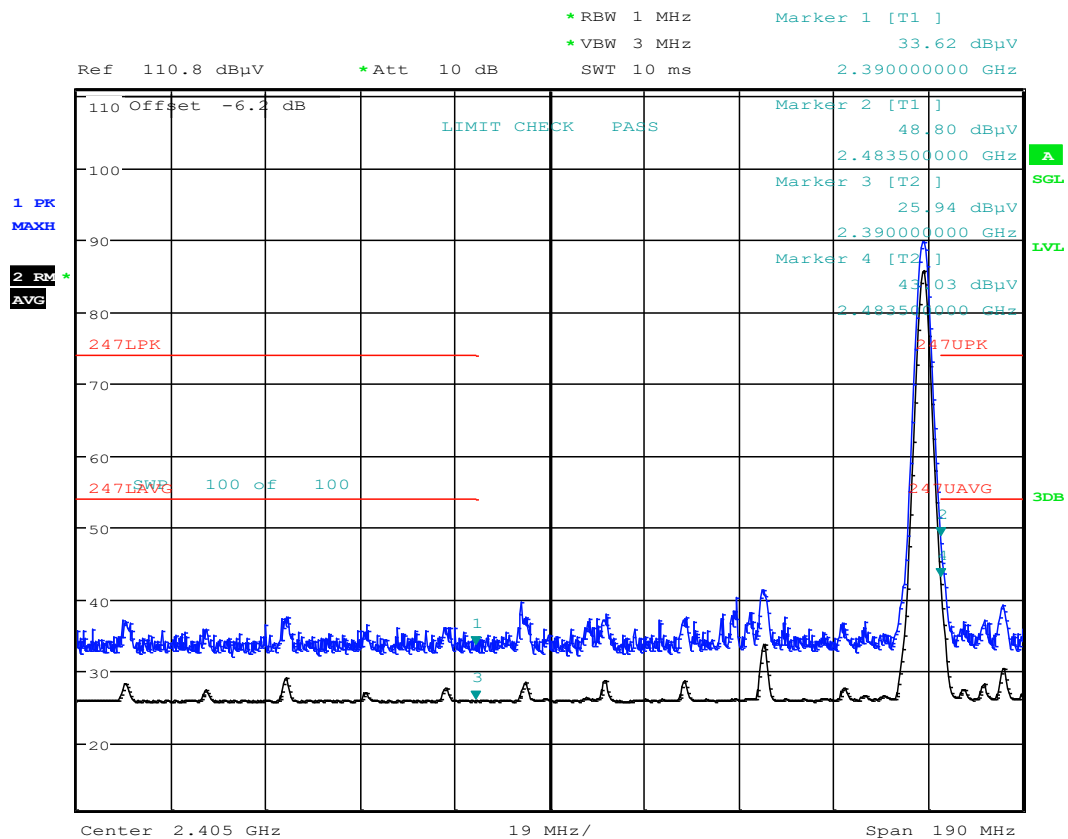
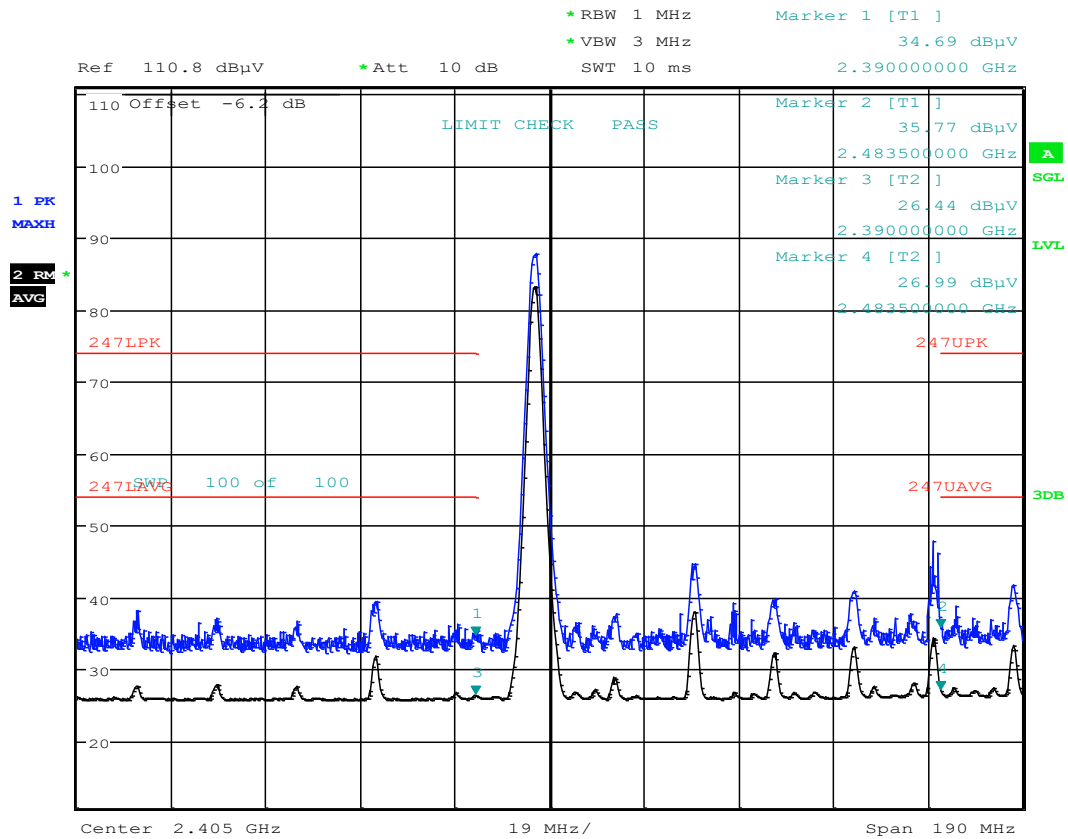


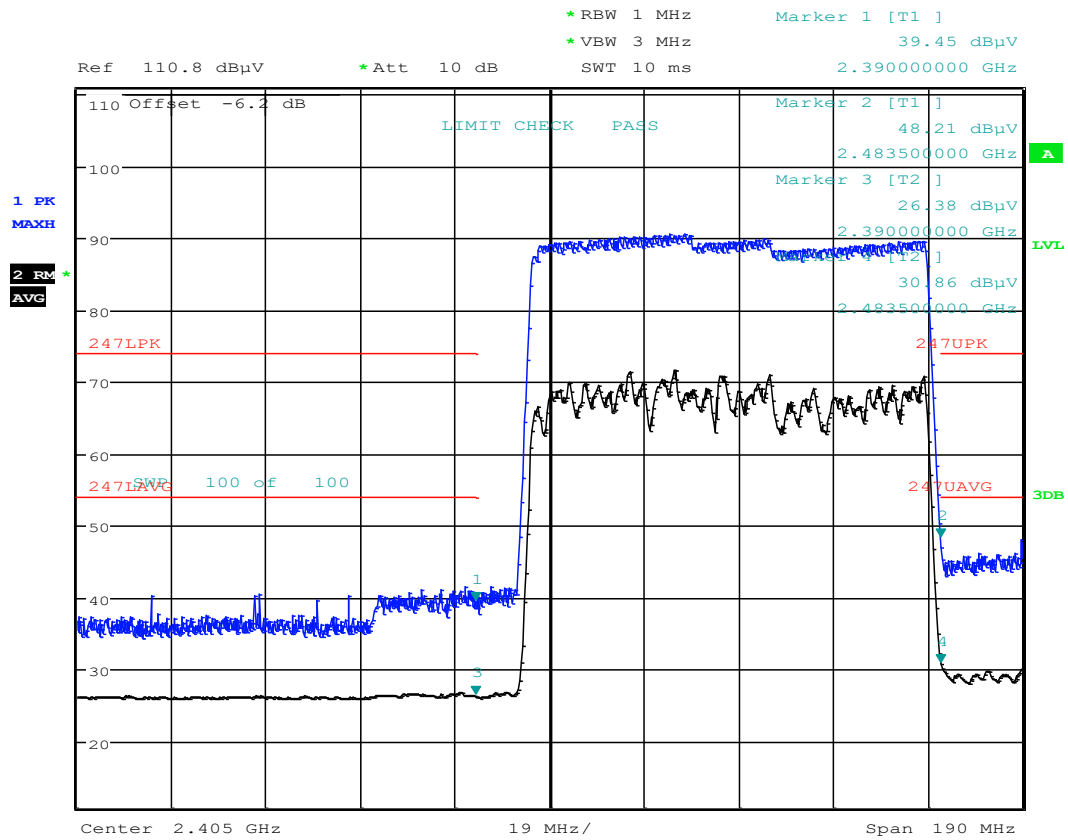
EDR 3-DH3



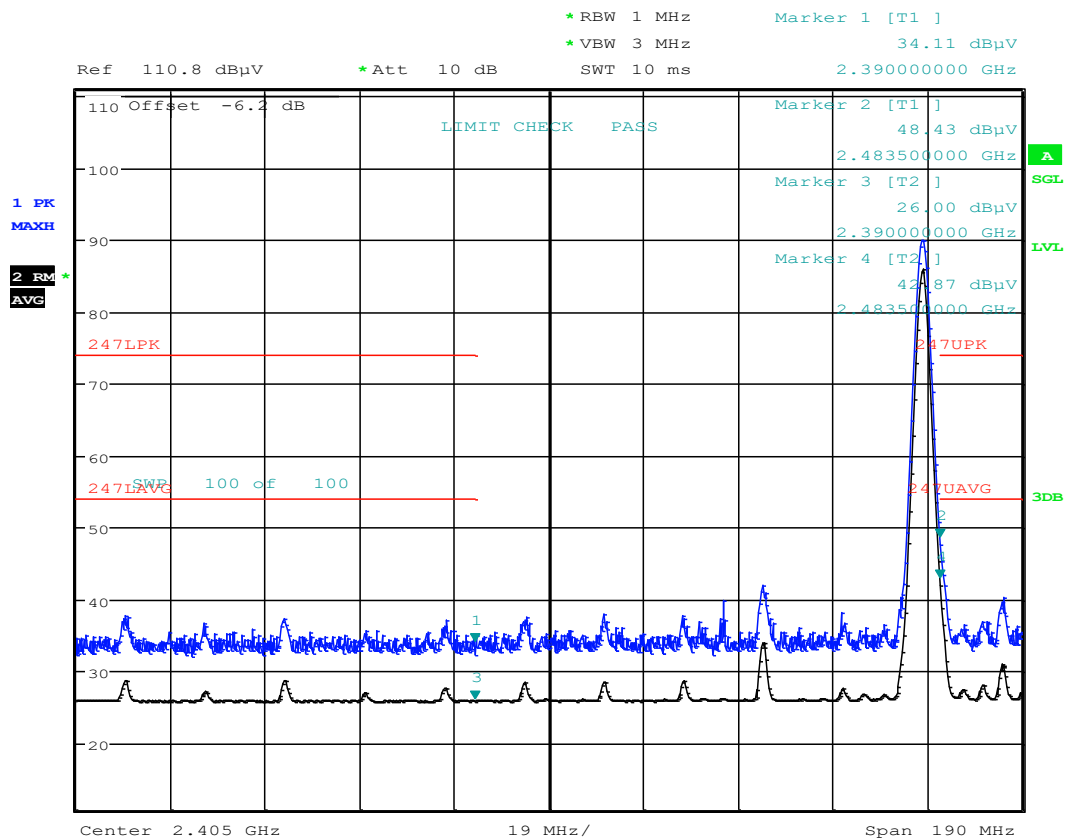
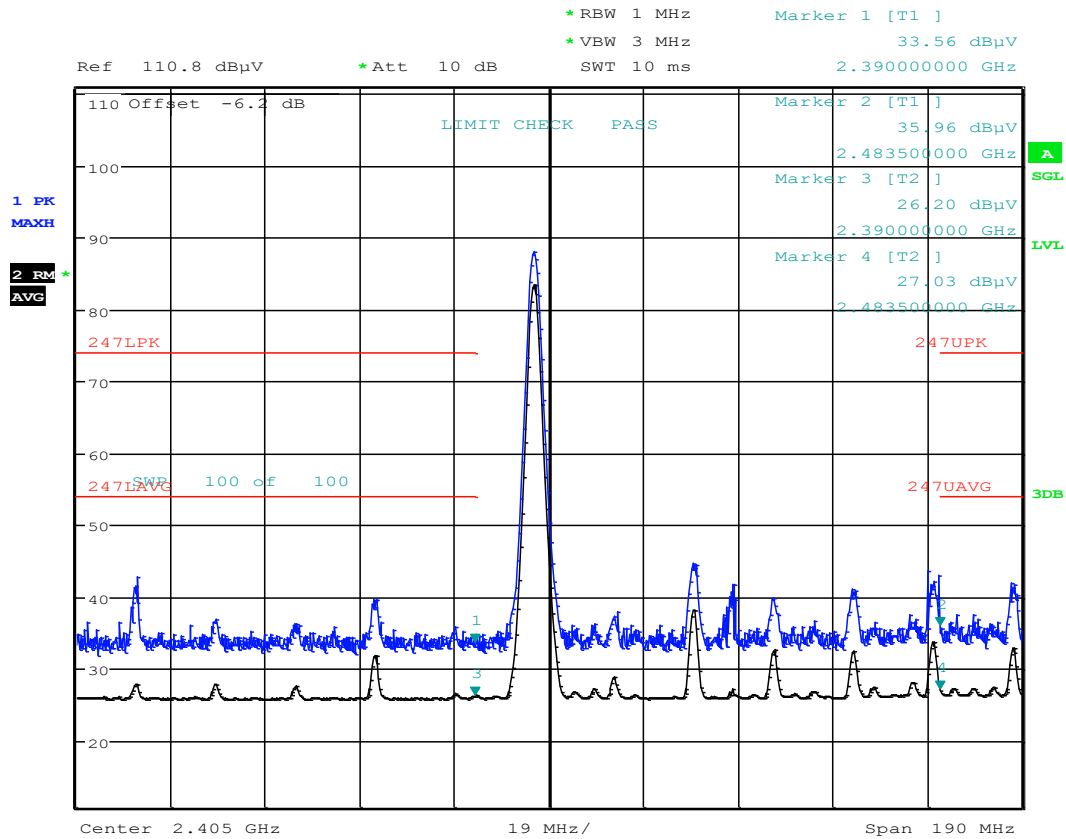


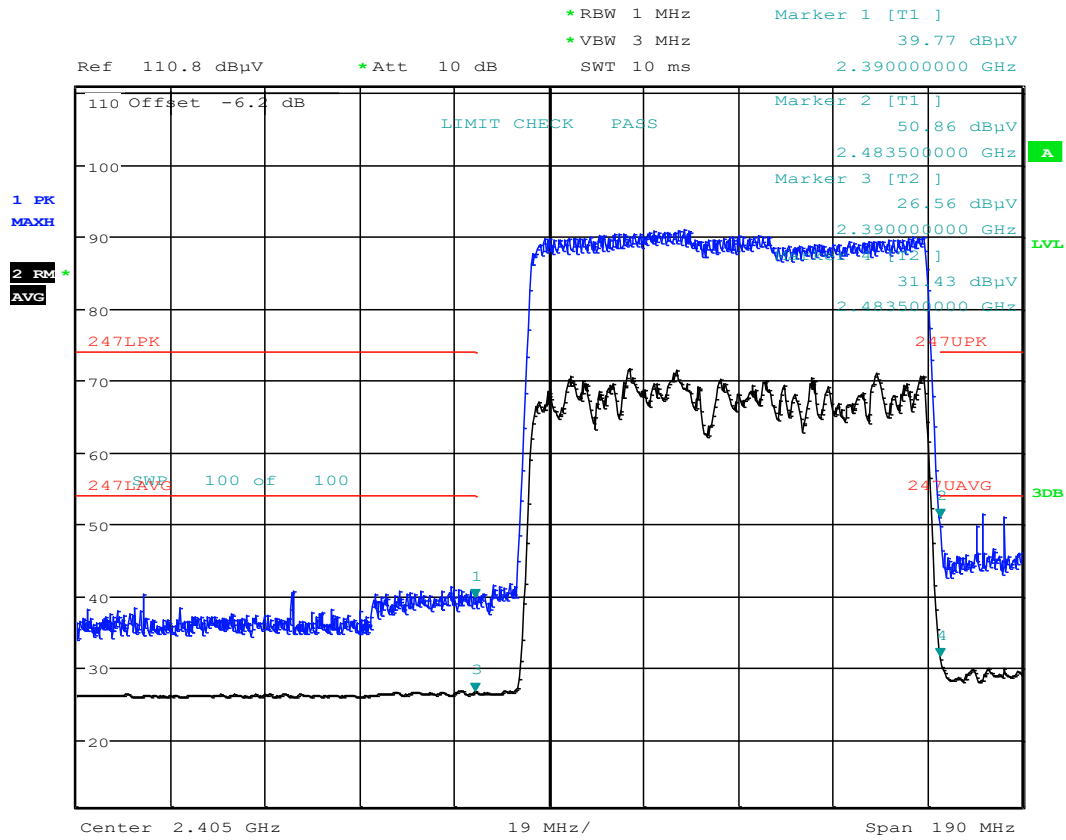
EDR 2-DH5





EDR 3-DH5





Conducted Spurious Emissions

Engineer: Aaron S. Froehlich

Test Date: 11/09/21

Test Procedure

Conducted Spurious Emissions has been measured using the methods of ANSI C63.10 clause 7.8.8. The antenna port was connected to a spectrum analyzer and the range of 30 MHz to 10 times the operating frequency was scanned with a resolution bandwidth of 100 kHz, video bandwidth of 300 kHz and a coupled sweep time. The frequency range was subdivided into 17 evenly spaced subranges with 30001 sweep points per subrange.

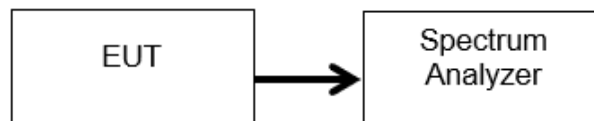
Per ANSI C63.10 Clause 5.6.2.2 b) the mode with the highest output power for each modulation family has been tested and reported.

Limits

47 CFR 15.247(d) & RSS 247 Section 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands, as defined in [§ 15.205\(a\)](#), must also comply with the radiated emission limits specified in [§ 15.209\(a\)](#) (see [§ 15.205\(c\)](#)).

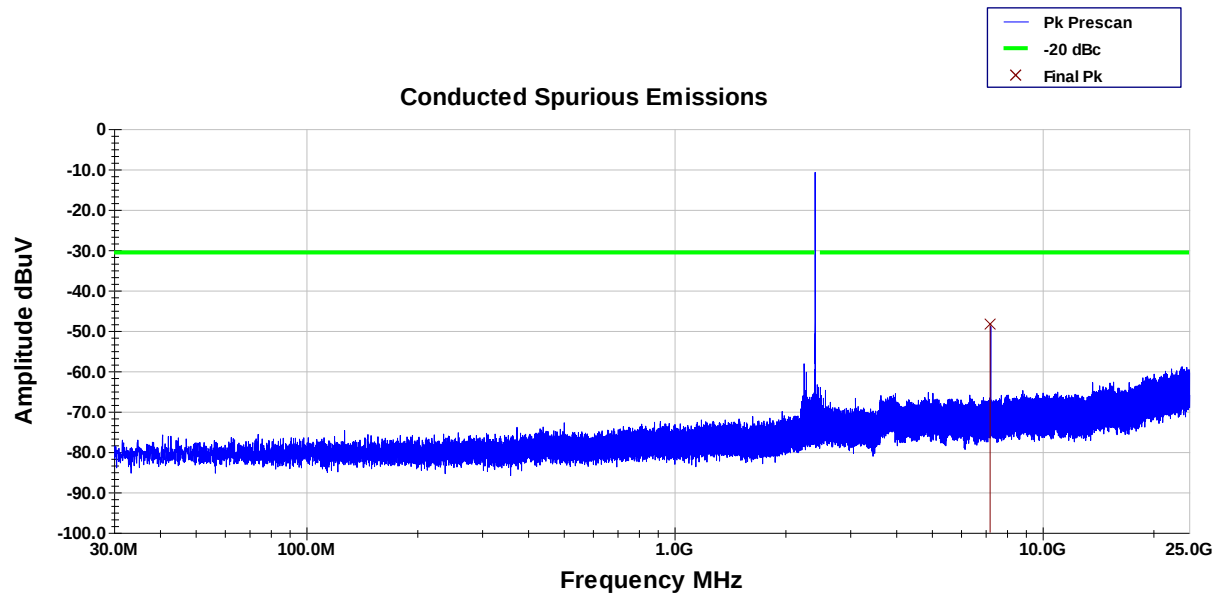
Test Setup



Test Data

BDR DH3

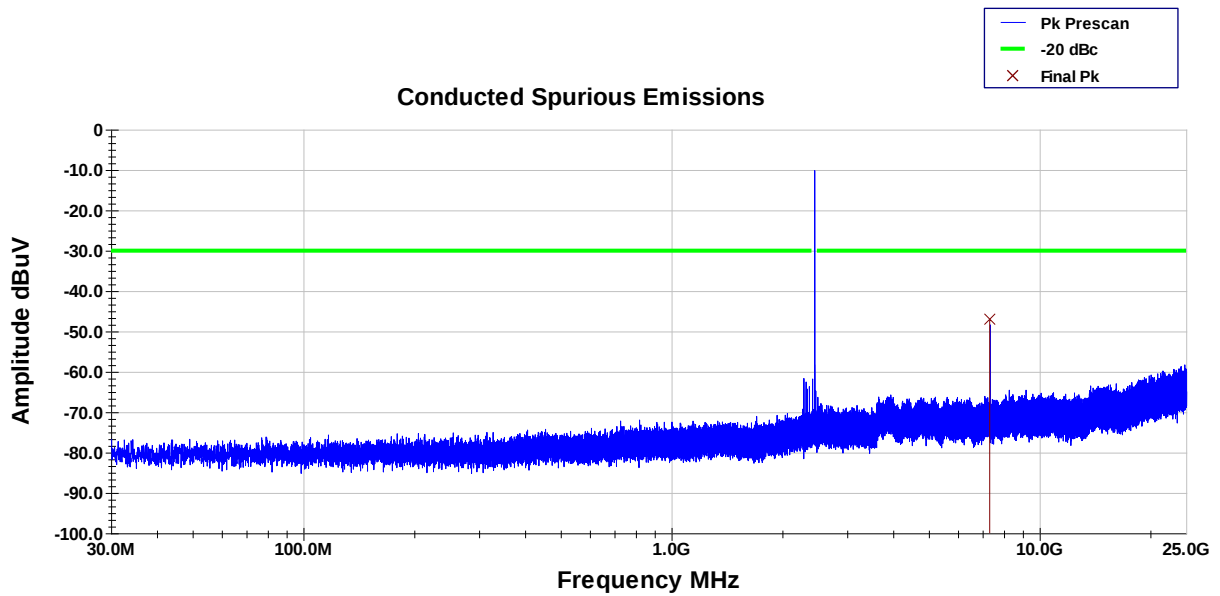
2402 MHz



Frequency	Raw Pk dBm	Path Loss dB	Final Pk dBm	Limit dBm	Pk Margin dB
7.2055 GHz	-50.597	-48.213	2.384	-30.612	-17.601

Final = Raw + Path Loss

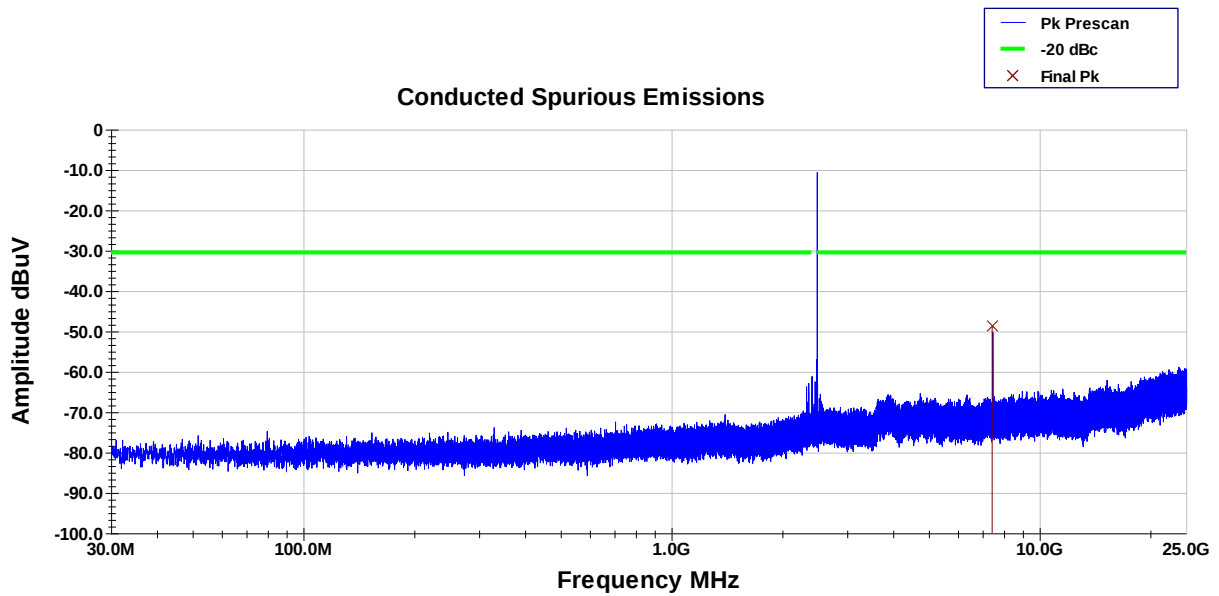
2441 MHz



Frequency	Raw Pk dBm	Path Loss dB	Final Pk dBm	Limit dBm	Pk Margin dB
7.3225 GHz	-49.574	2.419	-47.155	-30.033	-17.122

Final = Raw + Path Loss

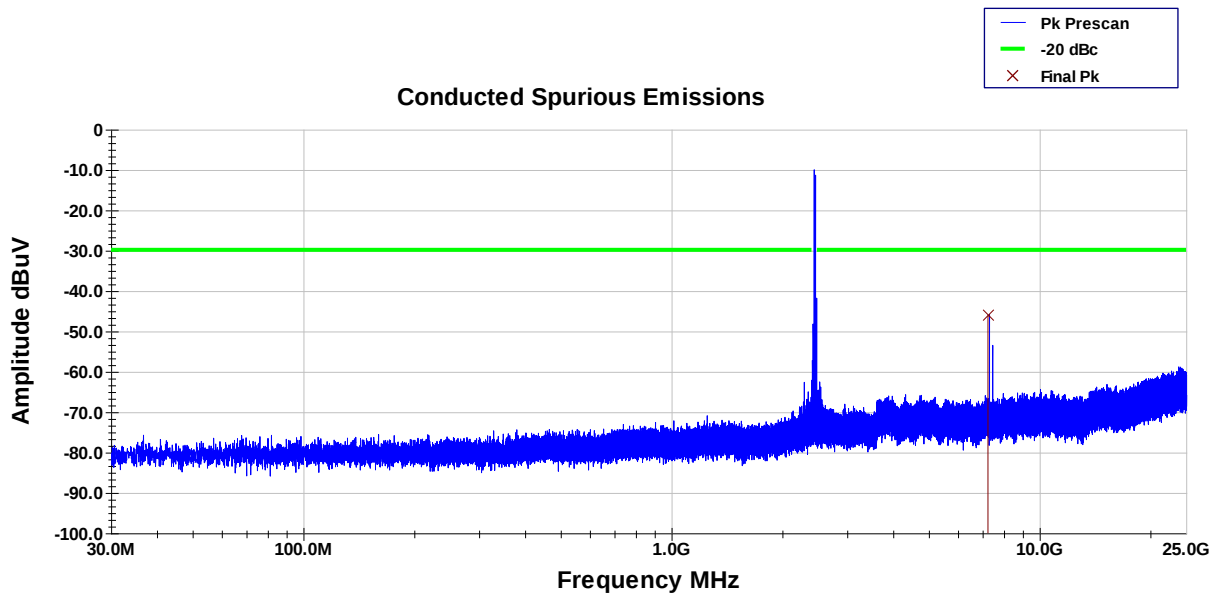
2480 MHz



Frequency	Raw Pk dBm	Path Loss dB	Final Pk dBm	Limit dBm	Pk Margin dB
7.4395 GHz	-51.234	2.458	-48.776	-30.465	-18.311

Final = Raw + Path Loss

Hopping

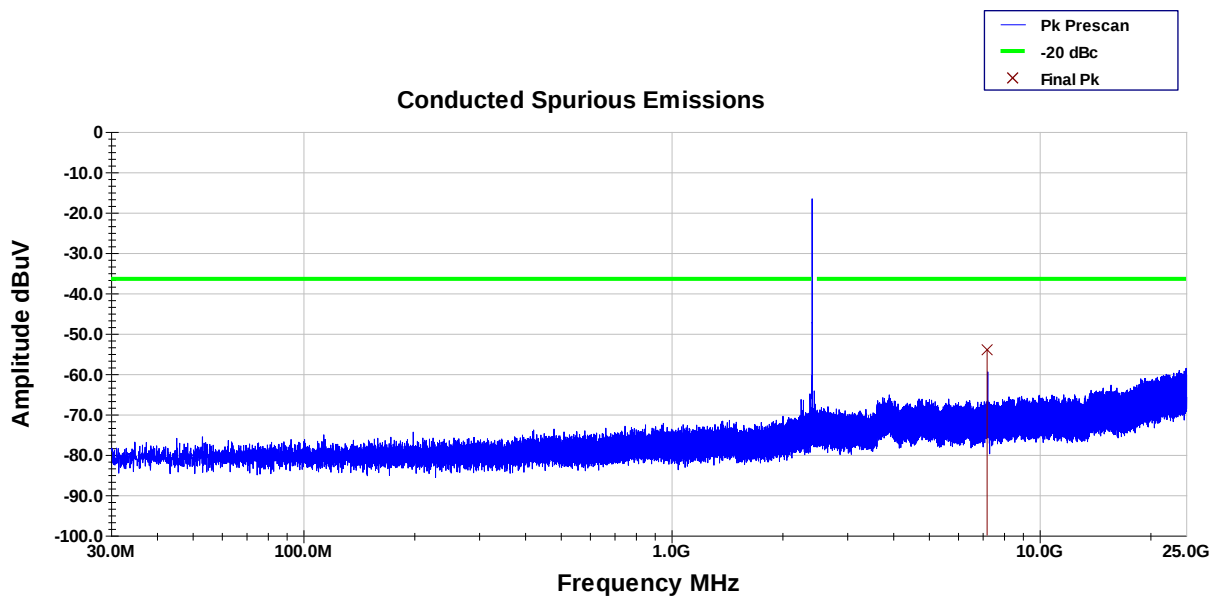


Frequency	Raw Pk dBm	Path Loss dB	Final Pk dBm	Limit dBm	Pk Margin dB
7.2455 GHz	-48.457	2.425	-46.032	-29.841	-16.191

Final = Raw + Path Loss

EDR 2-DH3

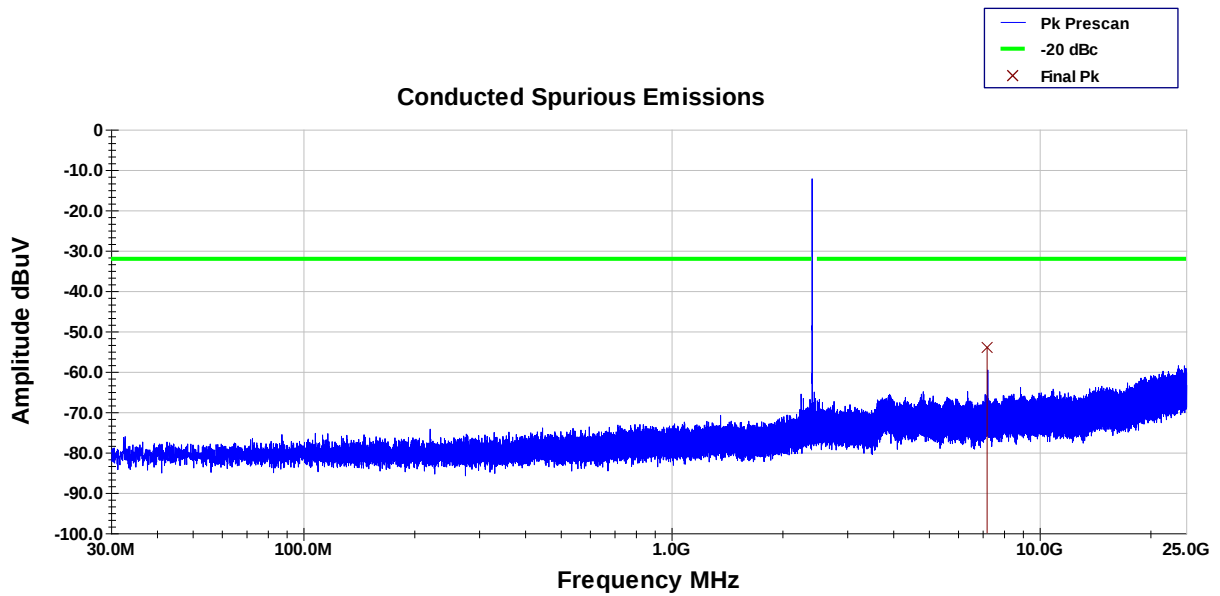
2402 MHz



Frequency	Raw Pk dBm	Path Loss dB	Final Pk dBm	Limit dBm	Pk Margin dB
7.206 GHz	-56.338	2.385	-53.953	-36.441	-17.512

Final = Raw + Path Loss

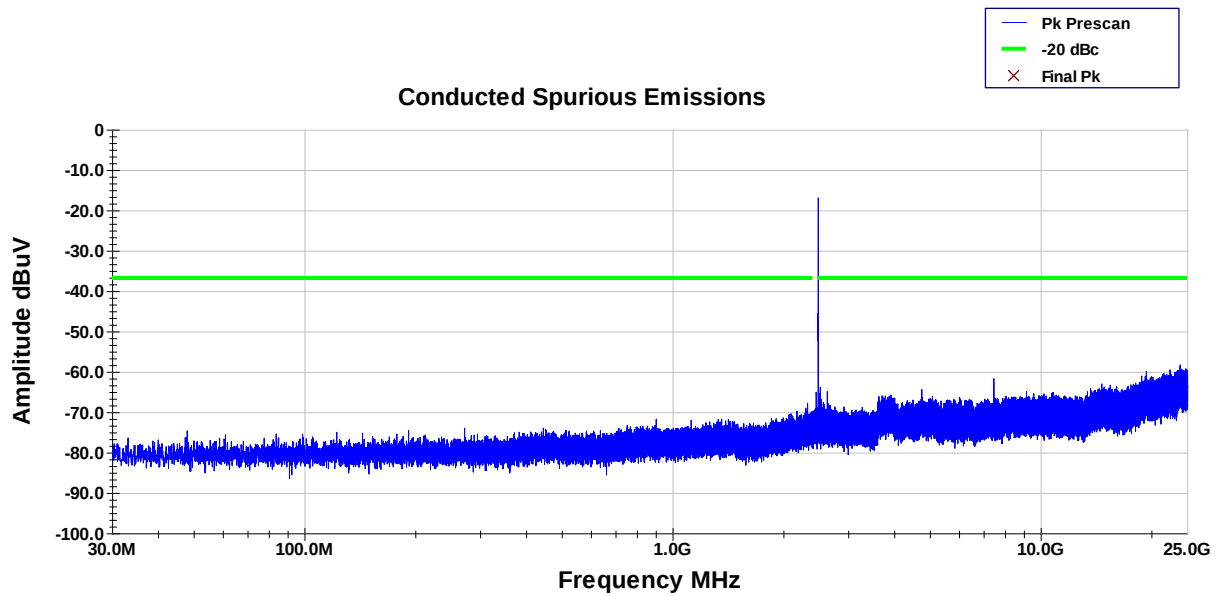
2441 MHz



Frequency	Raw Pk dBm	Path Loss dB	Final Pk dBm	Limit dBm	Pk Margin dB
7.2061 GHz	-56.344	2.385	-53.959	-32.071	-21.888

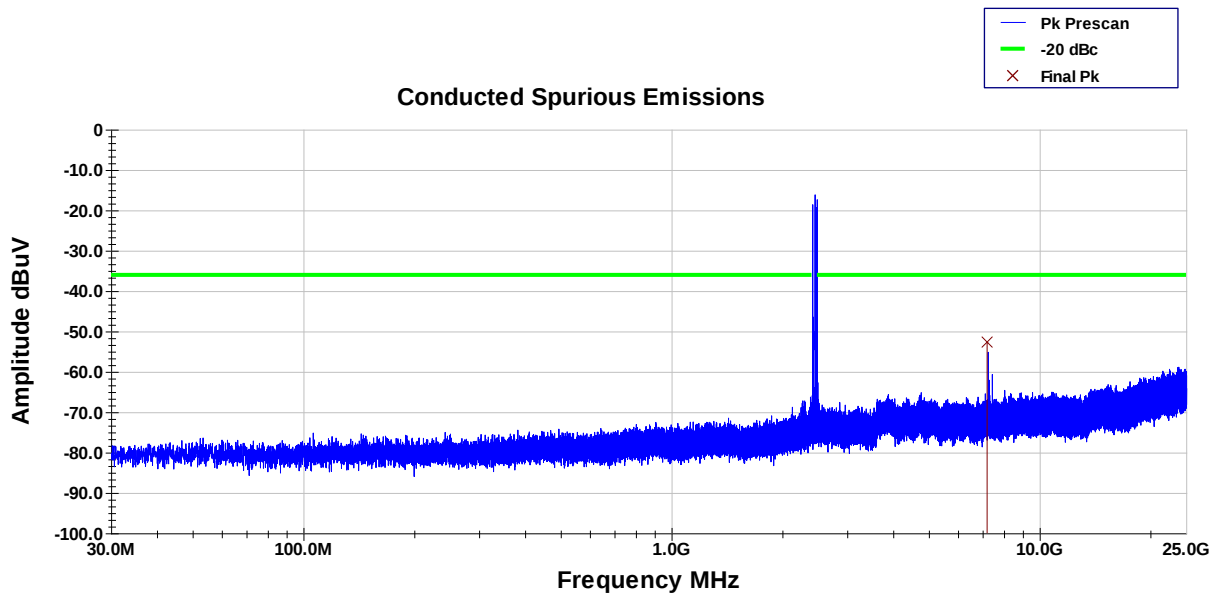
Final = Raw + Path Loss

2480 MHz



Spurious Levels > 20 dB below limit, no final data taken

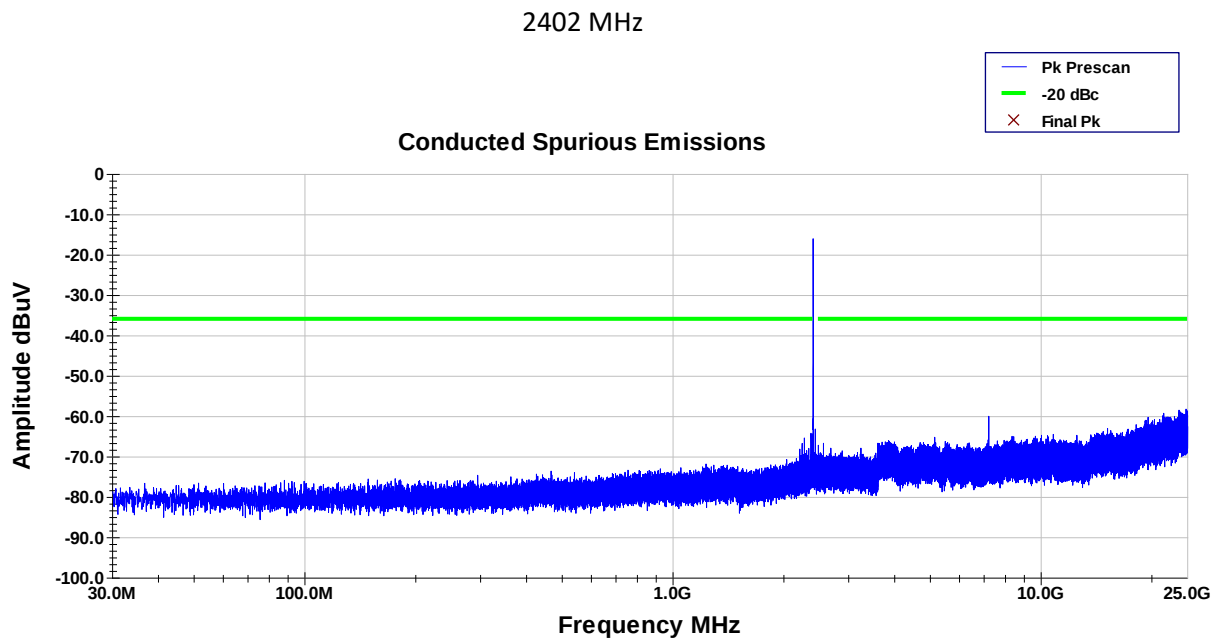
Hopping



Frequency	Raw Pk dBm	Path Loss dB	Final Pk dBm	Limit dBm	Pk Margin dB
7.2065 GHz	-55.097	2.386	-52.711	-36.035	-16.676

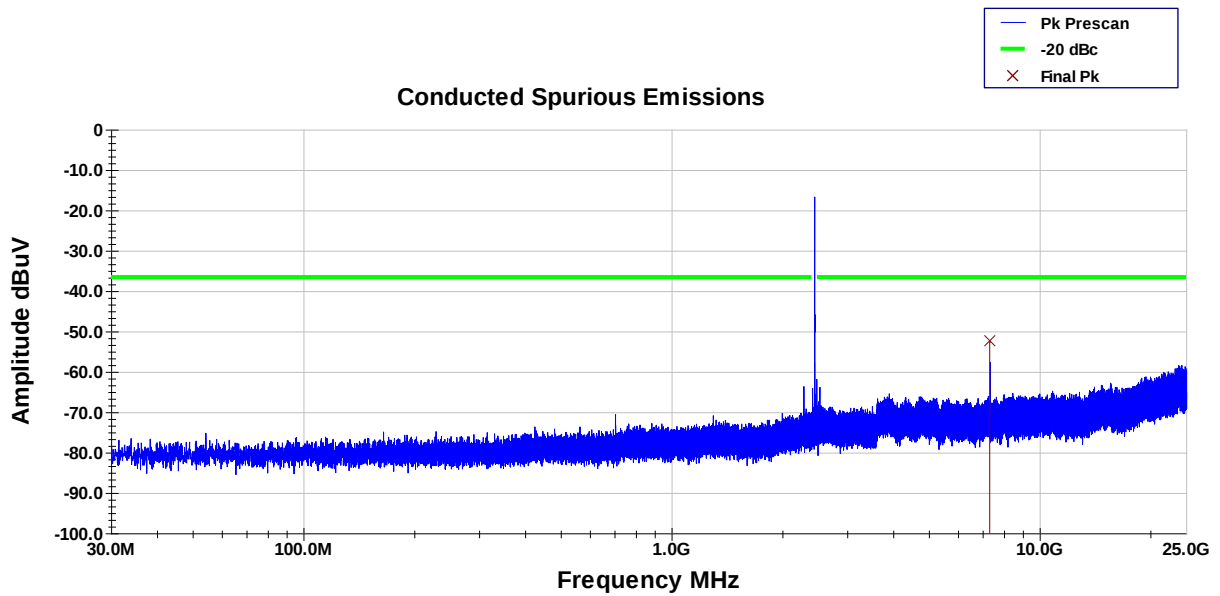
Final = Raw + Path Loss

EDR 3-DH3



Spurious Levels > 20 dB below limit, no final data taken

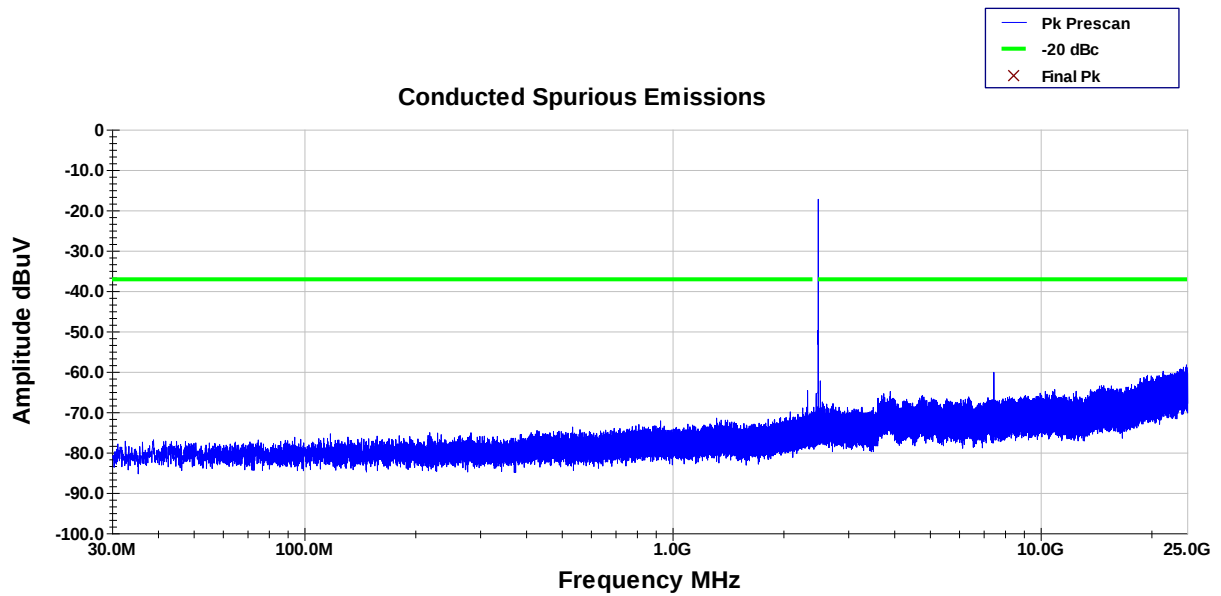
2441 MHz



Frequency	Raw Pk dBm	Path Loss dB	Final Pk dBm	Limit dBm	Pk Margin dB
7.3235 GHz	-54.903	2.415	-52.488	-36.581	-15.907

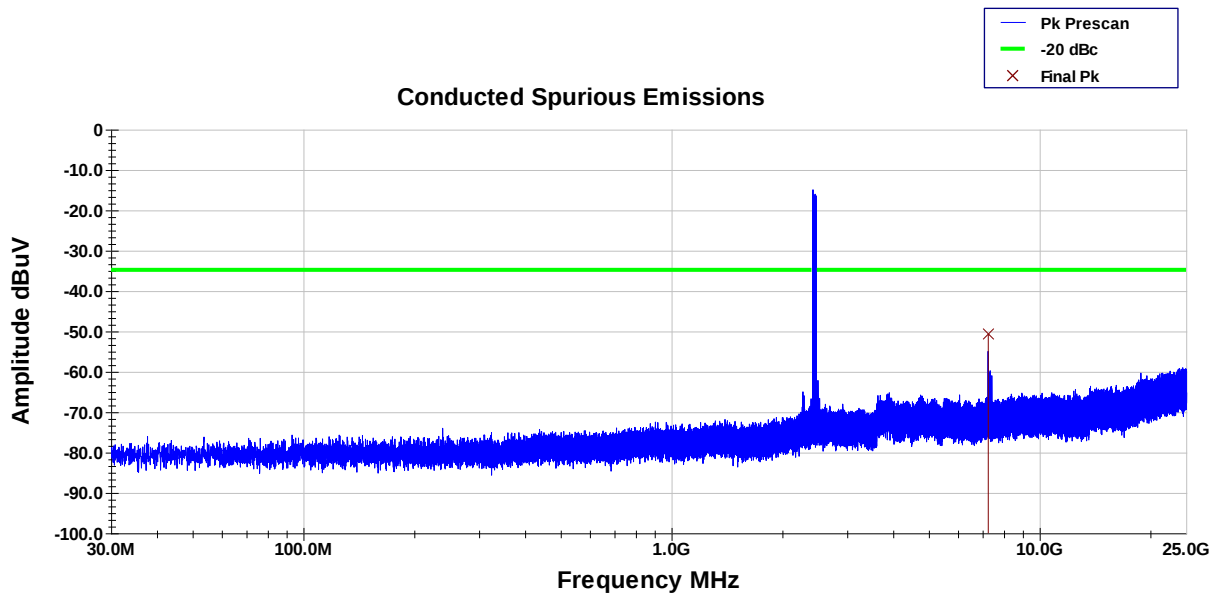
Final = Raw + Path Loss

2480 MHz



Spurious Levels > 20 dB below limit, no final data taken

Hopping

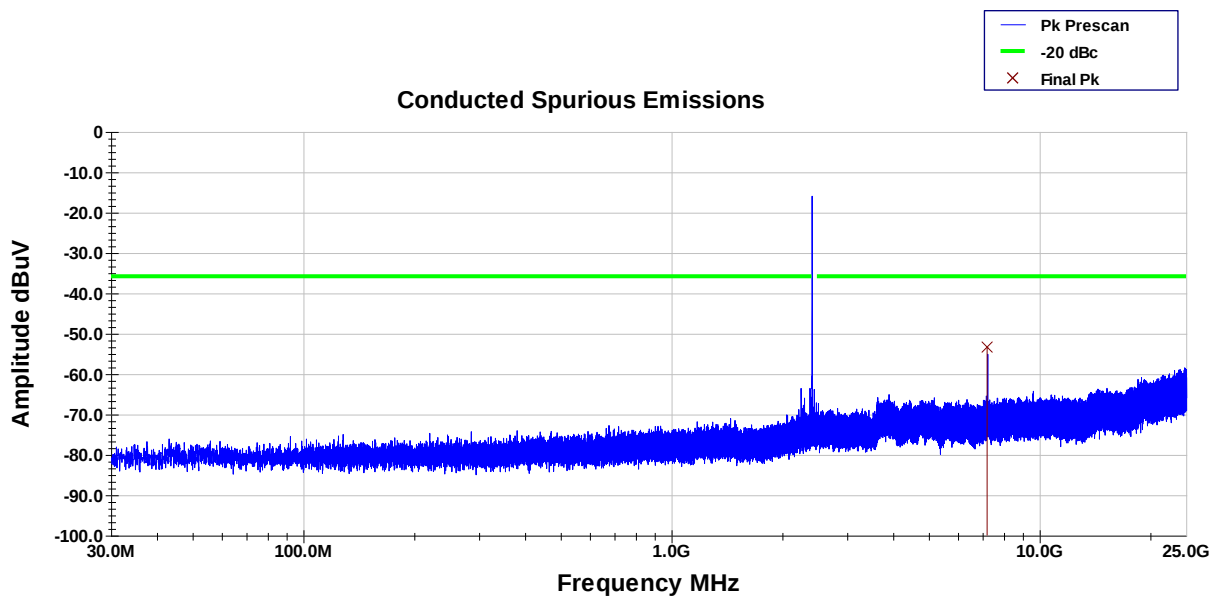


Frequency	Raw Pk dBm	Path Loss dB	Final Pk dBm	Limit dBm	Pk Margin dB
7.257 GHz	-53.171	2.421	-50.75	-34.785	-15.965

Final = Raw + Path Loss

EDR 3-DH5

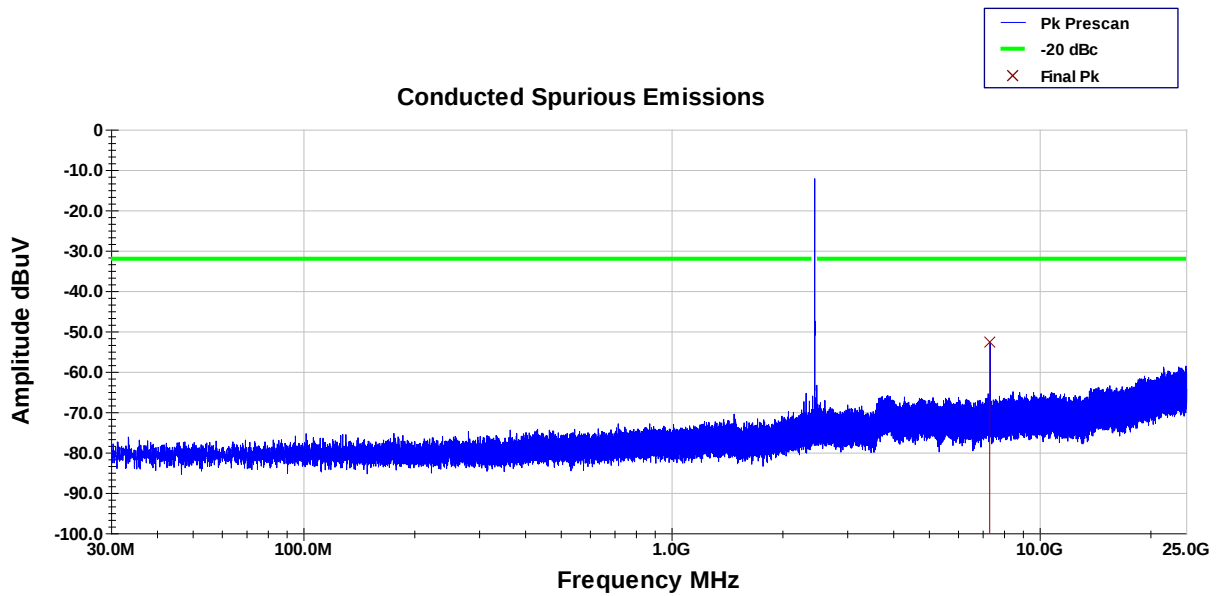
2402 MHz



Frequency	Raw Pk dBm	Path Loss dB	Final Pk dBm	Limit dBm	Pk Margin dB
7.2065 GHz	-55.785	2.386	-53.399	-35.802	-17.597

Final = Raw + Path Loss

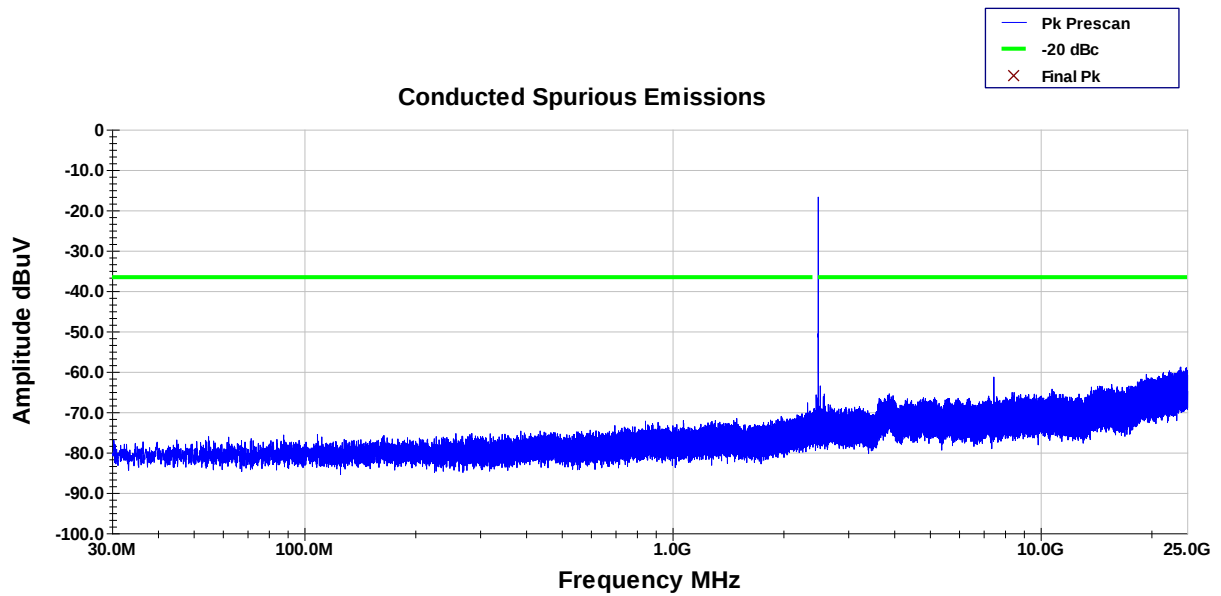
2441 MHz



Frequency	Raw Pk dBm	Path Loss dB	Final Pk dBm	Limit dBm	Pk Margin dB
7.3225 GHz	-55.25	2.419	-52.831	-32.038	-20.793

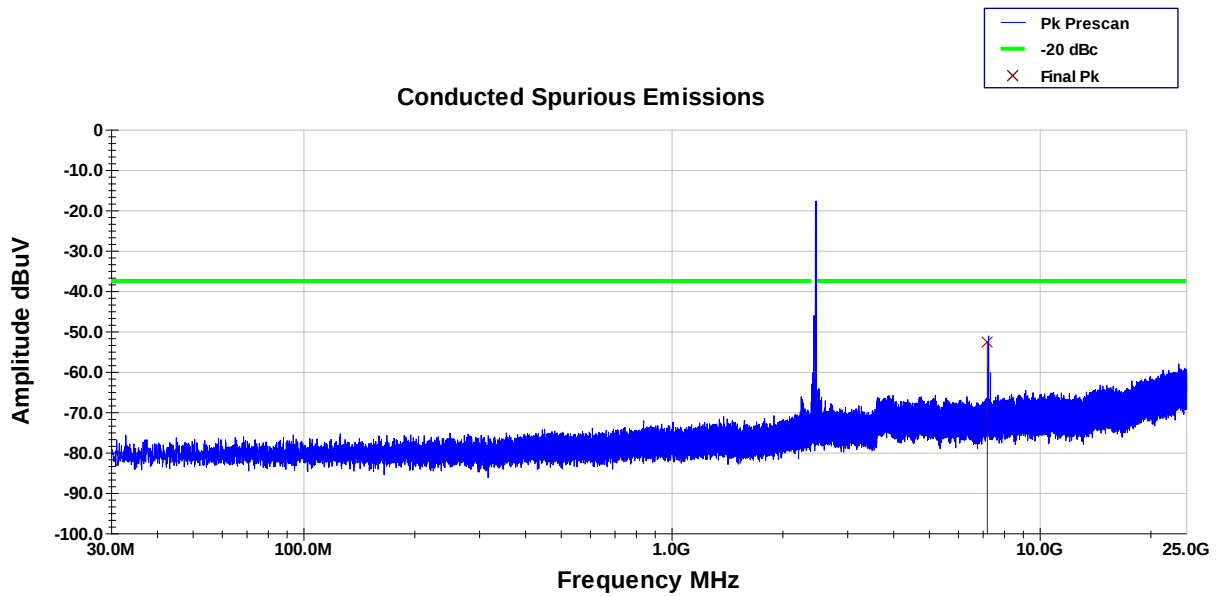
Final = Raw + Path Loss

2480 MHz



Spurious Levels > 20 dB below limit, no final data taken

Hopping



Frequency	Raw Pk dBm	Path Loss dB	Final Pk dBm	Limit dBm	Pk Margin dB
7.2178 GHz	-55.191	2.417	-52.774	-37.552	-15.222

Final = Raw + Path Loss

Radiated Spurious Emissions

Engineer: Aaron S. Froehlich

Test Date: 11/15/21

Test Procedure: 30-1000 MHz

The EUT was setup in a semi-anechoic test chamber set 3m from the receiving antenna. The EUT was set to transmit on the lowest, middle and highest frequency of operation, as well as frequency hopping, at the maximum power level. The EUT was tested, in 3 orthogonal axis, by rotating it 360° with the receive antenna in both the vertical and horizontal orientation while raised from 1 to 4 meters to ensure the TX signal levels were maximized. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Spurious Emissions.

All emissions from 30 MHz to 1 GHz were examined.

Measured Level includes antenna and receiver cable correction factors.

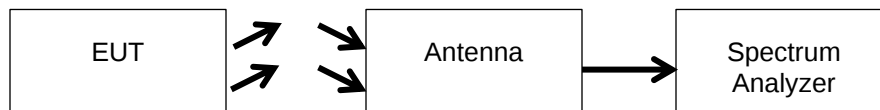
Correction factors were input into the spectrum analyzer before recording "Measured Level".

RBW = 100 KHz

VBW = 300 KHz

Detector – Quasi Peak

Test Setup



Test Procedure: ≥ 1 GHz

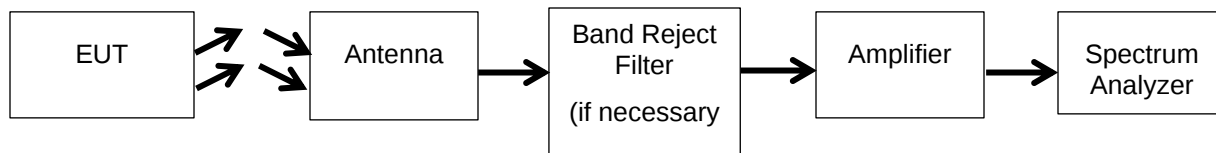
The EUT was setup in a semi-anechoic test chamber set 3m from the receiving antenna. The EUT was set to transmit on the lowest, middle and highest frequency of operation at the maximum power level. The EUT was tested, in 3 orthogonal axis, by rotating it 360° with the receive antenna in both the vertical and horizontal orientation while raised from 1 to 4 meters to ensure the TX signal levels were maximized. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Spurious Emissions.

RBW = 1 MHz

VBW = 3 MHz

Detector – Peak

Test Setup



Worst Case Emission:

Data Rate	Tx Freq MHz	Frequency MHz	Azimuth deg	Height cm	Raw Pk dBuV	Raw Avg dBuV	Correction dB	Final Pk dBuV/m	Pk Limit dBuV/m	Peak Margin dB	Final Avg dBuV/m	Avg Limit dBuV/m	Avg Margin dB
BDR DH3	2480	7439.442	83	258	59.09	49.95	2.427	61.517	74	-12.483	52.378	54	-1.622

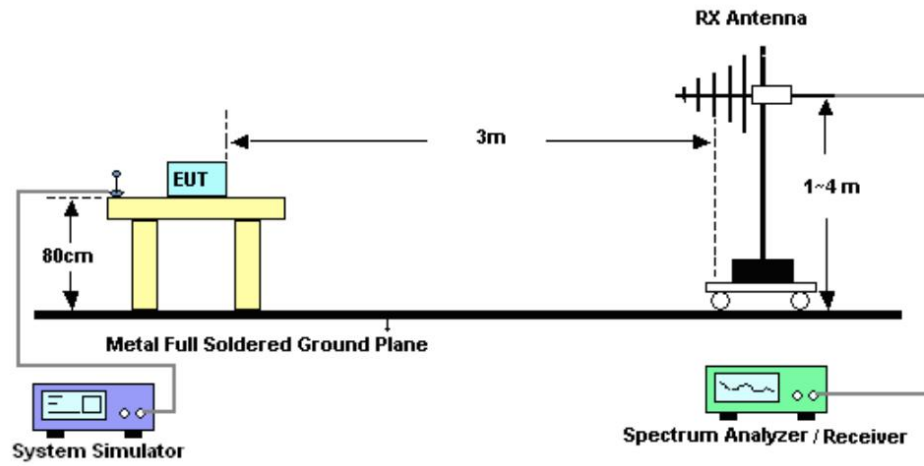
Final = Raw + Correction

Margin = Final - Limit

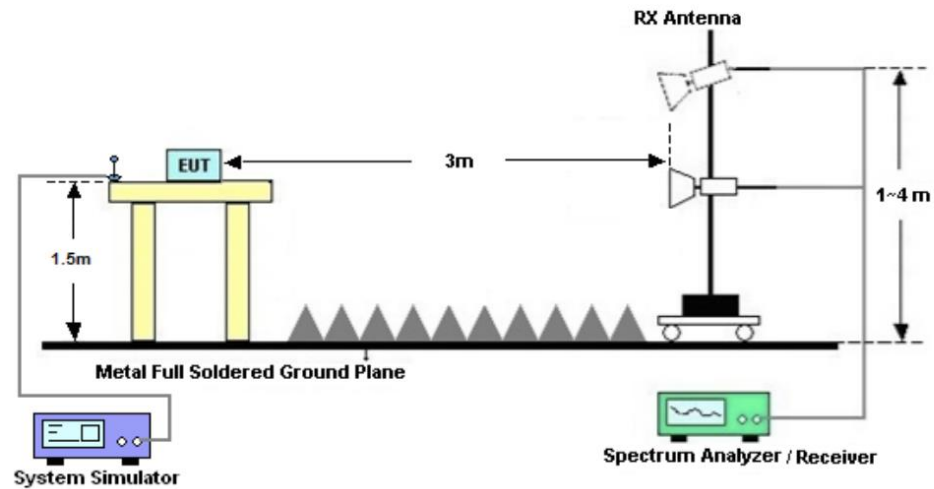
See Annex A for full test data

Chamber Setup Diagrams

For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



A/C Powerline Conducted Emission

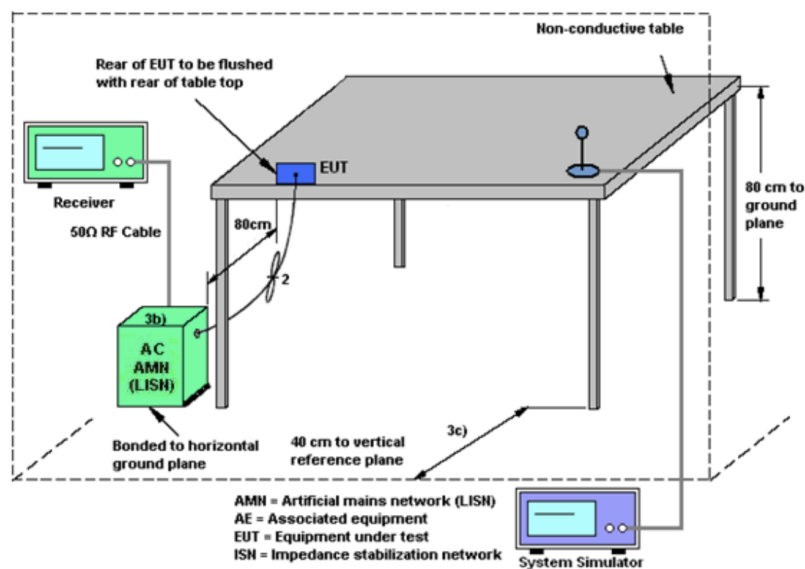
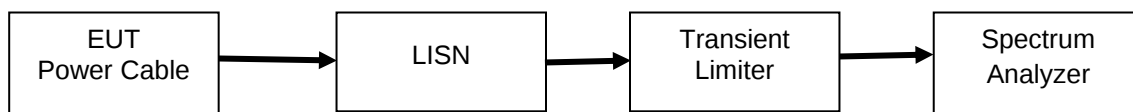
Engineer: Afzal Fazal

Test Date: 10/21/2021

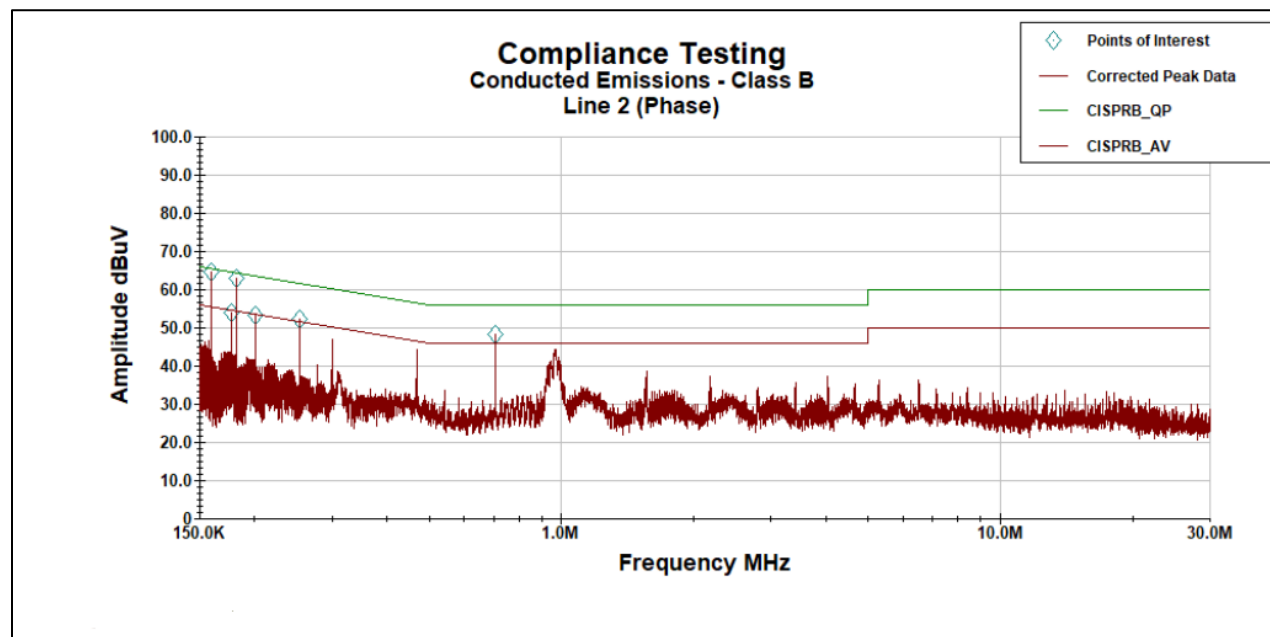
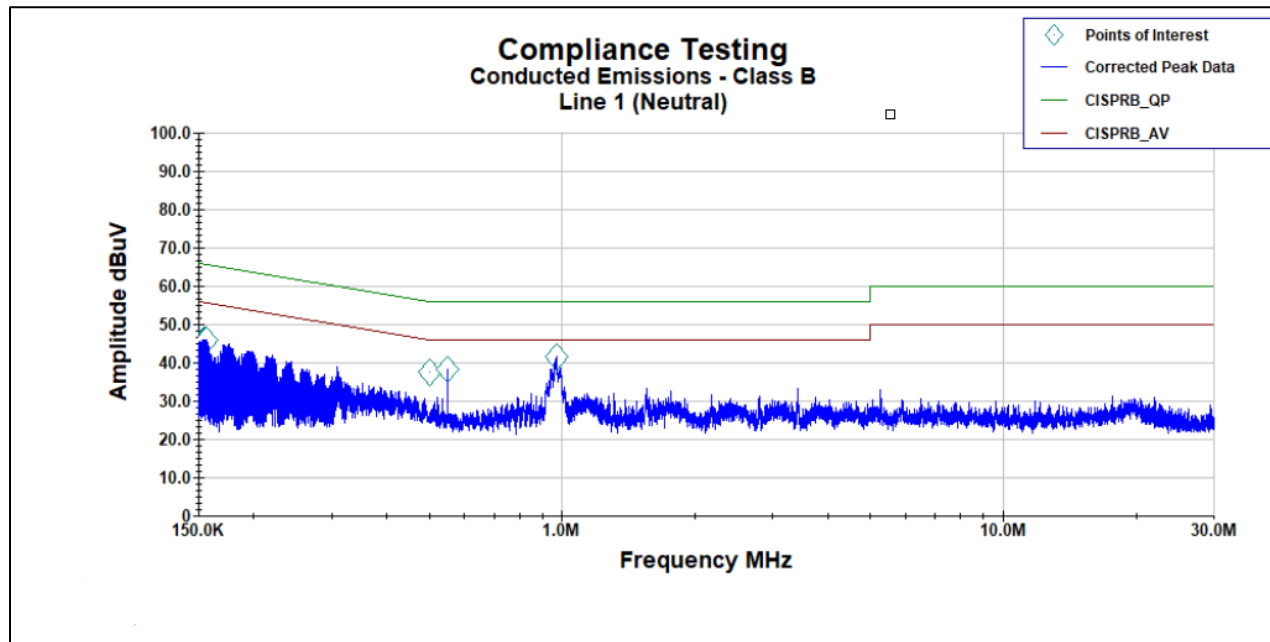
Test Procedure

The EUT power cable was connected to a LISN and the monitored output of the LISN was connected to a transient limiter, which then connected directly to a spectrum analyzer. The conducted emissions from 150 kHz to 30 MHz were measured and compared to the specification limits.

Test Setup



Test Data



Line 1 Neutral QP Detector

Frequency	Measured Value (dBuV)	LISN Correction Factor (dB)	Cable Loss (dB)	Transient Limiter (dB)	Final Data (dBuV)	Limit (dBuV)	Avg Margin (dB)
153.23 kHz	31.32	0.407	0.02	10.2	41.947	65.908	-23.961
154.23 kHz	31.56	0.403	0.02	10.2	42.183	65.879	-23.696
155.15 kHz	28.97	0.399	0.02	10.2	39.589	65.853	-26.263
481.9 kHz	10.83	0.114	0.03	10.1	21.074	56.517	-35.444
555.27 kHz	11.42	0.1	0.03	10.1	21.65	56	-34.35
970.61 kHz	28.98	0.09	0.04	10.1	39.21	56	-16.79

Line 1 Neutral Avg Detector

Frequency	Measured Value (dBuV)	LISN Correction Factor (dB)	Cable Loss (dB)	Transient Limiter (dB)	Final Data (dBuV)	Limit (dBuV)	Avg Margin (dB)
153.23 kHz	11.48	0.41	0.02	10.2	22.11	55.908	-33.798
154.23 kHz	12.72	0.4	0.02	10.2	23.343	55.879	-32.536
155.15 kHz	13.33	0.4	0.02	10.2	23.953	55.853	-31.9
481.9 kHz	1.69	0.11	0.03	10.1	11.93	46.517	-34.587
555.27 kHz	6.37	0.1	0.03	10.1	16.597	46	-29.403
970.61 kHz	21.22	0.09	0.04	10.1	31.453	46	-14.547

Line 2 Phase QP Detector

Frequency	Measured Value (dBuV)	LISN Correction Factor (dB)	Cable Loss (dB)	Transient Limiter (dB)	Final Data (dBuV)	Limit (dBuV)	QP Margin (dB)
150.53 kHz	30.81	0.44	0.02	10.2	41.468	65.985	-24.517
175.67 kHz	30.51	0.34	0.02	10.1	40.973	65.267	-24.294
194.87 kHz	28.97	0.29	0.02	10.1	39.38	64.718	-25.338
198.28 kHz	28.51	0.28	0.02	10.1	38.913	64.621	-25.707
242.55 kHz	24.47	0.21	0.022	10.1	34.804	63.356	-28.552
703.65 kHz	14.77	0.07	0.035	10.1	24.975	56	-31.025

Line 2 Phase Avg Detector

Frequency	Measured Value (dBuV)	LISN Correction Factor (dB)	Cable Loss (dB)	Transient Limiter (dB)	Final Data (dBuV)	Limit (dBuV)	QP Margin (dB)
150.53 kHz	12.25	0.44	0.02	10.2	22.905	55.985	-33.08
175.67 kHz	14.67	0.34	0.02	10.1	25.133	55.267	-30.134
194.87 kHz	13.11	0.29	0.02	10.1	23.517	54.718	-31.201
198.28 kHz	11.62	0.28	0.02	10.1	22.023	54.621	-32.597
242.55 kHz	11.12	0.21	0.022	10.1	21.457	53.356	-31.898
703.65 kHz	8.56	0.07	0.035	10.1	18.765	46	-27.235

Test Equipment Utilized

Description	Manufacturer	Model #	CT Asset #	Last Cal Date	Cal Due Date
Preamplifier	Eravant	S BB-0115034018-2F2F-E3	i00591	Verified on: 10/17/21	
Transient Limiter	Com-Power	LIT-153	i00123	Verified on: 10/21/21	
Bi-Log antenna	Chase	CBL6111C	i00267	8/28/20	8/28/22
Humidity / Temp Meter*	Newport	IBTHX-W-5	i00282	8/28/20	8/28/21*
EMI Analyzer	Agilent	E7405A	i00379	12/29/20	12/29/21
3 Meter Semi-Anechoic Chamber	Panashield	3 Meter Semi-Anechoic Chamber	i00428	7/17/20	7/17/23
LISN	Com-Power	LI-125A	i00447	4/28/20	4/28/22
LISN	Com-Power	LI-125A	i00449	4/28/20	4/28/22
Horn Antenna	ARA	DRG-118/A	i00271	8/3/20	8/3/22
EMI Analyzer	Rohde & Schwarz	FSU 26	i00501	5/19/21	5/19/22
EMI Receiver	Keysight	N9038A	i00552	1/12/21	1/12/22

*Calibration extended with the approval of Quality Manager.

In addition to the above listed equipment standard RF connectors and cables were utilized in the testing of the described equipment. Prior to testing these components were tested to verify proper operation.

Measurement Uncertainty

Measurement Uncertainty (U_{lab}) for Compliance Testing is listed in the table below.

Measurement	U_{lab}
Radio Frequency	$\pm 3.3 \times 10^{-8}$
RF Power, conducted	± 1.5 dB
RF Power Density, conducted	± 1.0 dB
Conducted Emissions	± 1.8 dB
Radiated Emissions	± 4.5 dB
Temperature	± 1.5 deg C
Humidity	± 4.3 %
DC voltage	± 0.20 VDC
AC Voltage	± 1.2 VAC

The reported expanded uncertainty $\pm U_{lab}(\text{dB})$ has been estimated at a 95% confidence level ($k=2$)

U_{lab} is less than or equal to U_{ETSI} therefore

- Compliance is deemed to occur if no measured disturbance exceeds the disturbance limit
- Non-Compliance is deemed to occur if any measured disturbance exceeds the disturbance limit