ENGINEERING TEST REPORT

Bi-Directional Amplifier System
Model:BDA380512
FCC ID: WDM-BDA380512

Applicant:
Comprod Communications Ltd
3405 North Benzing Road
Orchard Park, NY 14127
USA

Tested in Accordance With

Federal Communications Commission (FCC)
47 CFR, Parts 2, 90.219 & KDB 935210 D05

UltraTech's File No.: 18CMPR025Q_FCC90

This Test report is Issued under the Authority of Tri M. Luu Vice President of Engineering UltraTech Group of Labs Date: May 23, 2018	
Report Prepared by: Nimisha Desai and Santhosh Fernandez Issued Date: May 23, 2018	Tested by: Mrs. Nimisha Desai Test Dates: Feb 22 ~ Apr 20, 2018

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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Part 2,90.219 & KDB 935219 D05
Title:	Telecommunication - Code of Federal Regulations, CFR 47, Part 2 & 90
Purpose of Test:	To gain FCC Certification Authorization for Signal Booster operating in the Frequency Range 380-512 MHz
Test Procedures:	Both conducted and radiated emissions measurements were conducted in accordance with American National Standards Institute ANSI C63.4 - American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

1.2. RELATED SUBMITTAL(S)/GRANT(S)

None

1.3. NORMATIVE REFERENCES

Publication	Year	Title
FCC CFR Parts 2, 90	2017	Code of Federal Regulations – Title 47, Telecommunication
KDB 935210 D05	2017	Measurement Guidance for Industrial and Non-Consumer Signal Booster, Repeater and Amplifier Devices
ANSI C63.4	2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.26	2015	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services
ANSI/TIA-603-D	2010	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards
CISPR 16-1-1	2010	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus
RSS-131, Issue 3	2017	Zone Enhancers

EXHIBIT 2. PERFROMANCE ASSESSMENT

2.1. CLIENT INFORMATION

APPLICANT	
Name:	Comprod Communications Ltd
Address:	3405 North Benzing Road Orchard Park, NY 14127 USA
Contact Person:	Mr. Fernando Apolinario Phone #: 450-641-1454 Fax #: 450-641-4616 Email Address: fapolinario@comprodcom.com

MANUFACTURER	
Name:	Comprod Communications Ltd
Address:	88 Boulevard Industriel Boucherville, Quebec Canada J4B 2X2
Contact Person:	Mr. Fernando Apolinario Phone #: 450-641-1454, Ext.106 Fax #: 450-641-4616 Email Address: fapolinario@comprodcom.com

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

Brand Name:	Comprod Communications Ltd
Product Name:	Bi-Directional Amplifier System
Model Name or Number:	BDA1380512
Serial Number:	8F40309
Type of Equipment:	Bi-Directional Amplifier System
Power Supply Requirement:	115-220 VAC 50/60 Hz
Transmitting/Receiving Antenna Type:	External
Primary User Functions of EUT:	Amplify Radio Frequency Signals for land mobile radio communications; in building or places where RF is unable to penetrate from the base station site

2.3. EUT'S TECHNICAL SPECIFICATIONS

Transmitter	
Equipment Type:	Base station (fixed use)
Intended Operating Environment:	Commercial, industry or business environment
RF Output Power Rating (Conducted):	31.5 dBm or 1.412 Watts
Operating Frequency Range:	406.1-512 MHz
Channel Spacing:	6.25 kHz, 12.5 kHz & 25 kHz
RF Input/Output Impedance:	50 Ohm
Maximum Gain Specification: .	80 dB
Occupied Bandwidth (99%):	Same as of Input Signal BW
Emission Designation:	F3E & F1D
Antenna Connector Type:	Antenna connector type depends to that external diplexer used
Receiver	
Equipment Type:	Base station (fixed use)
Intended Operating Environment:	Commercial, industry or business environment
Power Supply Requirement:	115~220 VAC 50/60 Hz
Operating Frequency Range:	406.1-512 MHz

2.4. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	AC power input	1	3 pin CPC Connector	Non-shielded
3	RS Port(Active)	1	DB9	Shielded
4	RS Port(Inactive)	1	DB9	Shielded
5	D/L PA IN	1	N-Female	Shielded
6	U/L PA OUT	1	N-Female	Shielded
7	Dry Contact	2	16 Pin CPC Connector	Non-Shielded

2.5. ASSOCIATED EQUIPMENT

None

2.6. ANCILLARY EQUIPMENT

N/A

2.7. DRAWING OF TEST SETUP

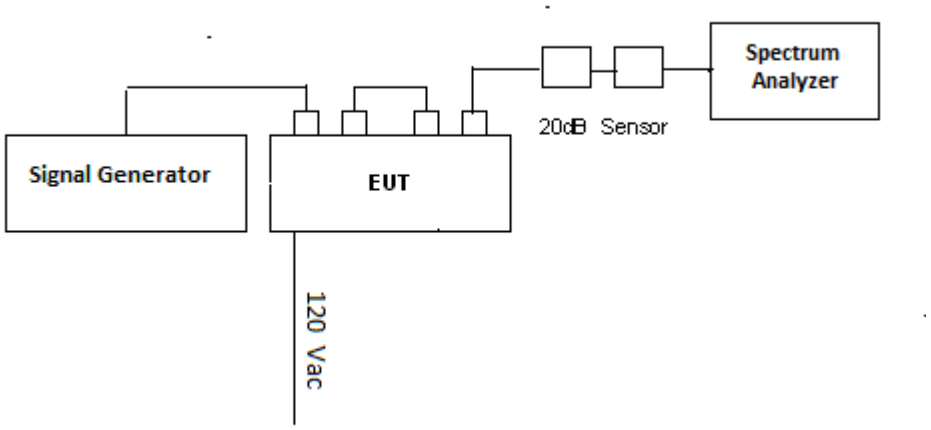


EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21-24°C
Humidity:	40-54%
Pressure:	100-102 kPa
Power input source:	120 VAC, 60 Hz

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TEST SIGNALS

Operating Modes:	The amplifier was operated in a continuous transmission mode with the carrier modulated as specified in the Test Data.
Special Test Software:	N/A
Special Hardware Used:	N/A
Transmitter Test Antenna:	The EUT is tested with the amplifier antenna ports terminated to a 50 Ohm RF Load.

Transmitter Test Signals	
Frequency Band(s):	406.1-512 MHz
Frequency(ies) Tested: (Near lowest, near middle & near highest frequencies in the frequency range of operation.)	406.2, 418, 429.9, 450.5, 459, 469.9, 511.975 MHz
Transmitter Wanted Output Test Signals: Transmitter Power (measured maximum output power): Normal Test Modulation: Modulating signal source:	 31.69 dBm F3E, F1D (Analog & Digital) External

EXHIBIT 4. SUMMARY OF TEST RESULTS

4.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

Radiated Emissions were performed at the Ultratech's 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. This test site been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville 3-10 TDK Semi-Anechoic Chamber has been filed with ANAB File No.: AT-1945.

4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Section(s)	Test Requirements	Compliance (Yes/No)
2.1033(c)(5) & 90.35	Frequency Band/Range of Operation	Yes
KDB 935210 D05	AGC Threshold	Yes
KDB 935210 D05	Out of Band Rejection	Yes
2.1046, KDB 935210 D05	RF Power Output (Conducted) & Gain	Yes
90.210 & 2.1049	Occupied Bandwidth & Emission Mask	Yes
2.1051	Spurious Emissions (Transmitter Conducted at Antenna Terminal)	Yes
2.1053	Radiated Spurious Emissions	Yes
KDB 935210 D05	Intermodulation	Yes
90.219(e)(2)	Noise Figure	Yes
2.1055 & 90.213	Frequency Stability	N/A EUT does not Implement Frequency Translation

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

Low pass filter (Mini-Circuits, 15542, NLP-500+) used to meet Transmitter Conducted at Antenna Terminal Requirements.
EMI Filter (Make: Qualtek Electronics Corp, 851-05/005) was used at Power supply and Ferrite (Steward, 28A2029-0A2 one turn) on top Dry contact cable was used to comply Radiated and Conducted Requirements.

4.4. DEVIATION OF STANDARD TEST PROCEDURES

None

EXHIBIT 5. Measurements, Examinations and Test Data

5.1. AGC Threshold

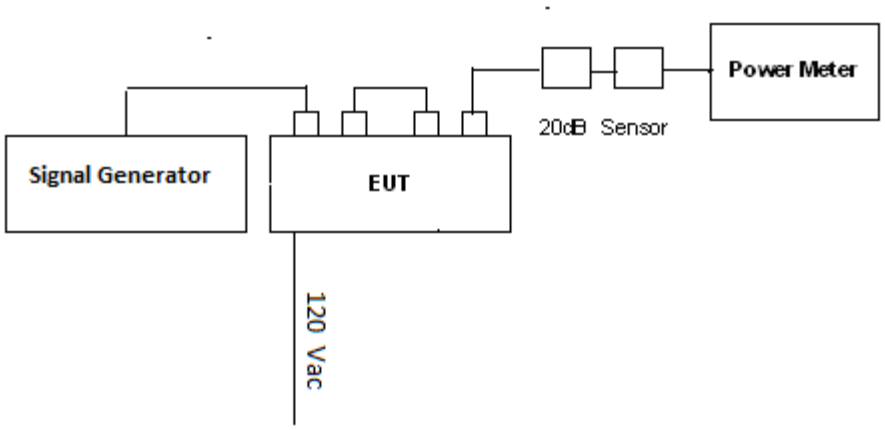
5.1.1. Method of Measurements

KDB 935210 D05, ANSI C63.26

5.1.2. Test Procedure

A signal generator producing a CW signal was connected to the input of the EUT. A Power meter with power sensor was connected to the EUT via 20dB attenuator in order to monitor the output power levels. The input power level was increase in the 1dB increment until the power no longer increased. The input levels were recorded in the table below.

5.1.3. Test Arrangement



5.1.4. Test Data

Frequencies (MHz)	Input Power (dBm)	Output Power (dBm)
406.2	-48.2	31.52
418.0	-47.9	31.45
429.9	-47.2	31.42
450.5	-46.6	31.50
459.0	-46.3	31.48
469.9	-46.2	31.48
511.975	-46.2	31.69

5.2. Out of Band Rejection

5.2.1. Method of Measurements

KDB 935210 D05 and ANSI C63.26

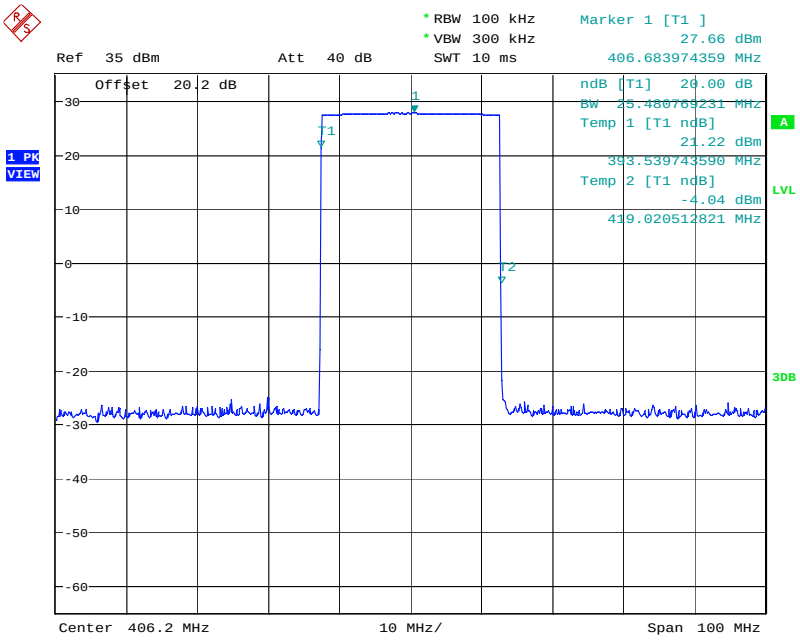
5.2.2. Test Procedure and arrangement

The EUT was connected to a spectrum analyzer through a 20dB power attenuator. A signal generator was utilized to produce a swept CW signal with the RF input level set to 3 DB below the AGC threshold level. The spectrum Analyzer was used to show the -20 dB bandwidth of the pass band filter on the high end and low end. In addition the high and low channels were swept to show the maximum bandwidth of the filter utilized.

5.2.3. Test Data

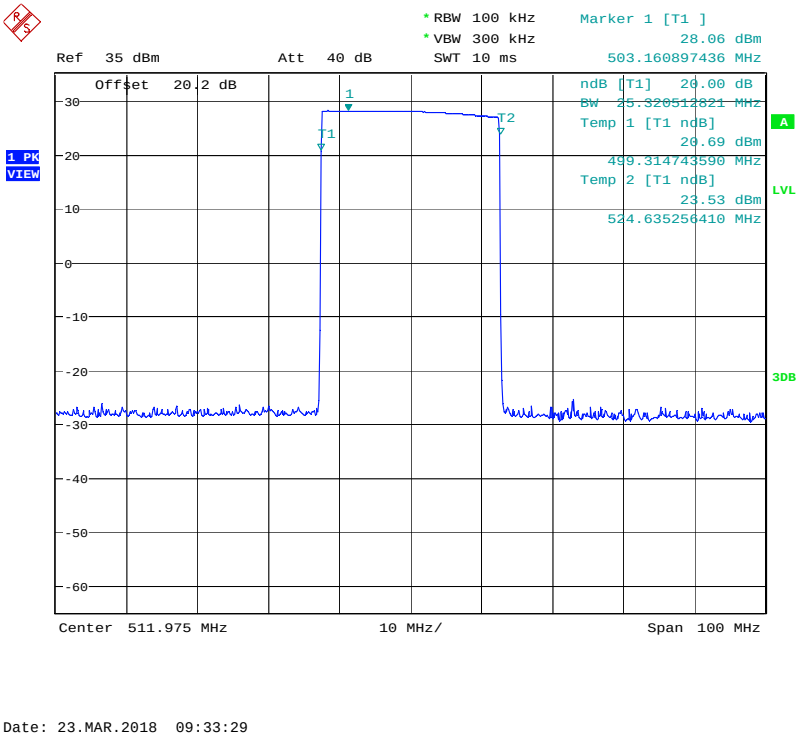
Configuration: 406.2MHz, CW, Signal Input 3dB below AGC
+/- 250% of Pass Band: 5 MHz = +/- 12.5 MHz
406.2 MHz: scan frequency (393.7 MHz to 418.7 MHz)

BW measured: 25.48 MHz



Configuration: 511.975MHz, CW, Signal Input 3dB below AGC
+/- 250% of Pass Band: 5 MHz = +/- 12.5 MHz
511.975 MHz: scan frequency (499.475 MHz to 524.475 MHz)

BW measured: 25.32 MHz



Note: Above are sample plots with signal input of +/- 12.5 MHz with a 5 MHz pass band.
In production actual unit, the manufacturer will employ filters that are within the FCC allocated bands for Part 90 and shall be attenuated below 20dB outside this allowed operating frequency. To demonstrate this Appendix C has typical filter responses at the band edges provided by manufacturer that have typical response compliant to the out of band rejection.

5.3. RF Power Output (Conducted) and Amplifier Gain

5.3.1. Limit

FCC 47 CFR § 90.219
(e) Device Specifications. In addition to the general rules for equipment certification in § 90.203(a)(2) and part 2, subpart J of this chapter, a signal booster must also meet the rules in this paragraph.
(1) The output power capability of a signal booster must be designed for deployments providing a radiated power not exceeding 5 Watts ERP for each retransmitted channel.

5.3.2. Method of Measurement

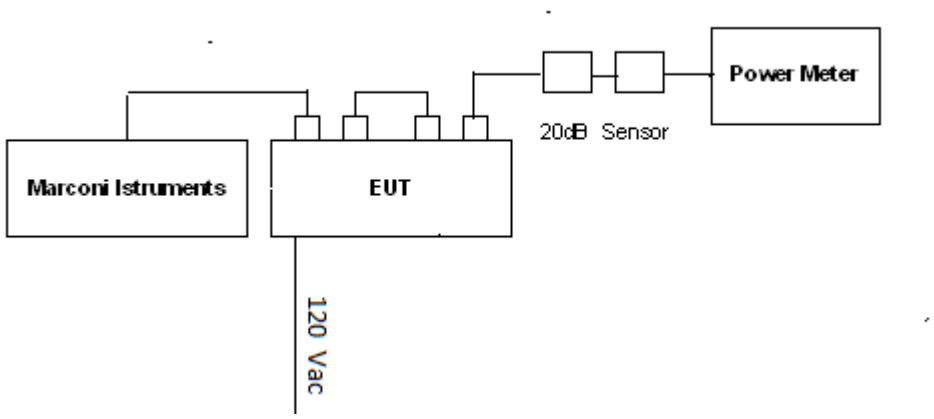
KDB 935210 Do5, ANSI C63.26

5.3.3. Test Procedure

A signal generator producing a CW signal was connected to the input of the EUT. A Power meter with power sensor was connected to the EUT via 20dB attenuator in order to monitor the output power levels. The RF input level was set to 0.2dB below the AGC Threshold. The input and output power levels were recorded and gain was calculated using the following formula:

Gain (dB) =Output Power (dBm) - Input Power (dBm)

5.3.4. Test Arrangements



5.3.5. Test Data

Frequencies (MHz)	Input Power (dBm)	Measured (dBm)	Output Power (dBm)	Gain (dB)	Rated Power (dBm)	Limit (dBm)
406.2	-48.33	11.03	31.23	79.56	31.50	37
418.0	-48.00	11.05	31.25	79.25	31.50	37
429.9	-47.30	11.29	31.49	78.79	31.50	37
450.5	-46.71	10.99	31.19	77.90	31.50	37
459.0	-46.42	11.08	31.28	77.70	31.50	37
469.9	-46.32	11.07	31.27	77.59	31.50	37
511.975	-46.33	11.32	31.52	77.85	31.50	37

5.4. OCCUPIED BANDWIDTH & EMISSION MASK

5.4.1. Limits

The spectral shape of the output should look similar to input for all modulations and within the applicable masks as per Sec 90.209 & 90.210.

5.4.2. Method of Measurements

KDB 935210 Do5, C63.26

5.4.3. Test Procedure

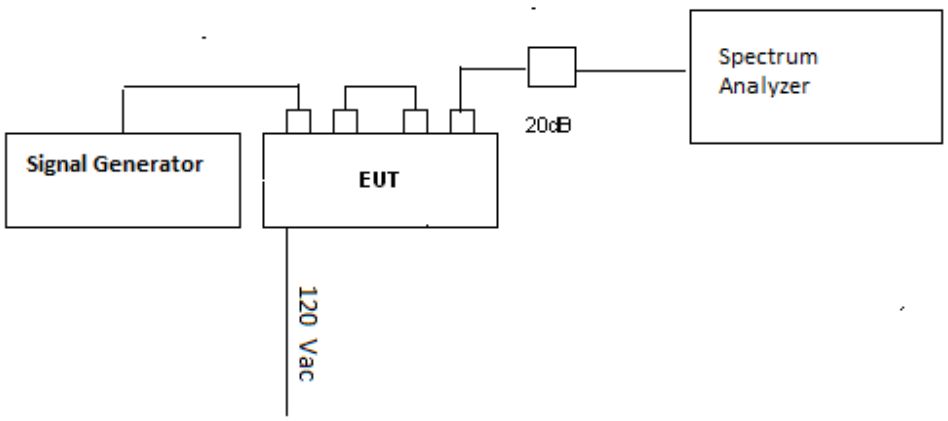
The EUT was connected directly to a spectrum analyzer to verify that the EUT meets the required emissions mask. The EUT is a booster amplifier that does not contain a transmitter; representative emission designators used in the industry were used for the emission masks and are listed in Table below:

Emission Designator	Emission Mask	Type of Modulation	Occupied Bandwidth (KHz)	Channel Spacing (KHz)	Audio Frequency (KHz)	Deviation (KHz)	RBW (Hz)
16K0F3E	C	FM	16.0	25	1.0	5.0	300
11K3F3E	D	FM	11.3	12.5	1.0	2.5	100
4K00F1E	E	FM	4	6.25	1.0	1.0	100

Emission Designator	Emission Mask	Type of Modulation	Occupied Bandwidth (KHz)	Channel Spacing (KHz)	Symbol Rate (ksym/s)	FSK Deviation (KHz)	RBW (Hz)
F1D	E	4FSK	4	6.25	2.5	0.900	100
F1D	D	4FSK	7.5	12.5	4	2.0	100

The output signal was tested to the required mask.
The input signal was recorded and compared to the output signal.
The input and output was tested at 0.2 dB below the AGC Threshold and +3 dB above the AGC Threshold.

5.4.4. Test Arrangement



5.4.5. Test Data

Amplitude level 0.2dB below AGC

Test Frequency (MHz)	Digital (6.25 kHz) IN (kHz)	Digital (6.25 kHz) OUT (kHz)	Digital (12.5 kHz) IN (kHz)	Digital (12.5 kHz) OUT (kHz)	Analog (6.25 kHz) IN (kHz)	Analog (6.25 kHz) OUT (kHz)	Analog (12.5 kHz) IN (kHz)	Analog (12.5 kHz) OUT (kHz)	Analog (25 kHz) IN (kHz)	Analog (25 kHz) OUT (kHz)
406.2	3.65	3.69	7.40	7.40	4.07	4.07	7.93	7.93	12.42	12.34
418	3.46	3.56	7.31	7.50	4.07	4.07	7.93	7.93	12.42	12.42
429.9	3.59	3.65	7.16	7.31	4.07	4.07	7.93	7.93	12.42	12.42
450.5	3.62	3.59	7.36	7.45	4.07	4.07	7.93	7.93	12.42	12.42
459	3.53	3.69	7.36	7.40	4.07	4.07	7.93	7.93	12.34	12.34
469.9	3.59	3.59	7.31	7.50	4.07	4.07	7.93	7.93	12.42	12.49
511.965	3.56	3.56	7.26	7.31	4.07	4.07	7.93	7.93	12.42	12.34

Amplitude level 3dB above AGC

Test Frequency (MHz)	Digital (6.25 kHz) IN (kHz)	Digital (6.25 kHz) OUT (kHz)	Digital (12.5 kHz) IN (kHz)	Digital (12.5 kHz) OUT (kHz)	Analog (6.25 kHz) IN (kHz)	Analog (6.25 kHz) OUT (kHz)	Analog (12.5 kHz) IN (kHz)	Analog (12.5 kHz) OUT (kHz)	Analog (25 kHz) IN (kHz)	Analog (25 kHz) OUT (kHz)
406.2	3.71	3.49	7.36	7.40	4.07	4.07	7.93	7.93	12.42	12.34
418	3.56	3.59	7.31	7.30	4.07	4.07	7.93	7.93	12.42	12.42
429.9	3.69	3.56	7.31	7.40	4.07	4.07	7.93	7.93	12.42	12.42
450.5	3.56	3.59	7.36	7.40	4.07	4.07	7.93	7.93	12.42	12.34
459	3.56	3.65	7.50	7.40	4.07	4.07	7.93	7.93	12.34	12.34
469.9	3.62	3.62	7.26	7.31	4.07	4.07	7.93	7.93	12.42	12.42
511.965	3.62	3.69	7.26	7.40	4.07	4.07	7.93	7.93	12.42	12.34

Refer to Annex A for Emission Mask and OBW plots

5.5. Conducted Spurious Emissions (Antenna Terminal)

5.5.1. Limits

Emissions shall be attenuated below the mean output power of the transmitter as follows:

§ 90.219 (c) Class A narrowband boosters must meet the out-of-band emission limits of § 90.210 for each narrowband channel that the booster is designed to amplify. Class B broadband signal boosters must meet the emission limits of § 90.210 for frequencies outside of the booster's designed pass band.

(e) (3) Spurious emissions from a signal booster must not exceed −13 dBm within any 100 kHz measurement bandwidth.

5.5.2. Measurement Procedure

KDB 935210 Do5, C63.26 & 90.210

5.5.3. Test Procedure

The EUT was connected to spectrum analyzer through 20dB power attenuator. A CW signal was utilized, set to 7 different frequency test frequency.

The RF input signal level was set to 0.2dB below the AGC threshold.

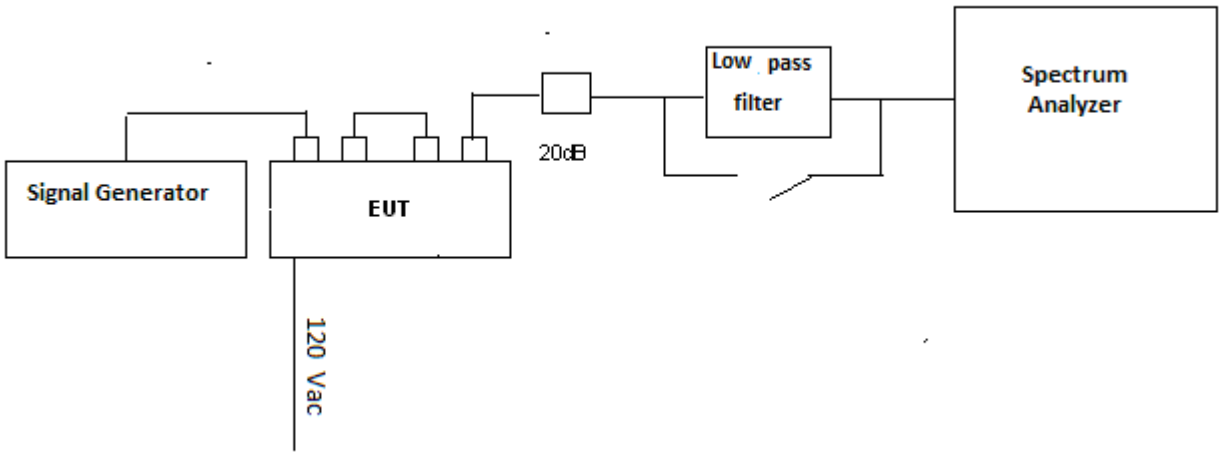
The frequency range fro, 30 MHz to the 10th harmonic of the pass band frequency was observed and plotted.

The following formula was used for calculating the limits.

Conducted Spurious Emissions Limit = P1-(43+10Log (P2)) = -13dBm

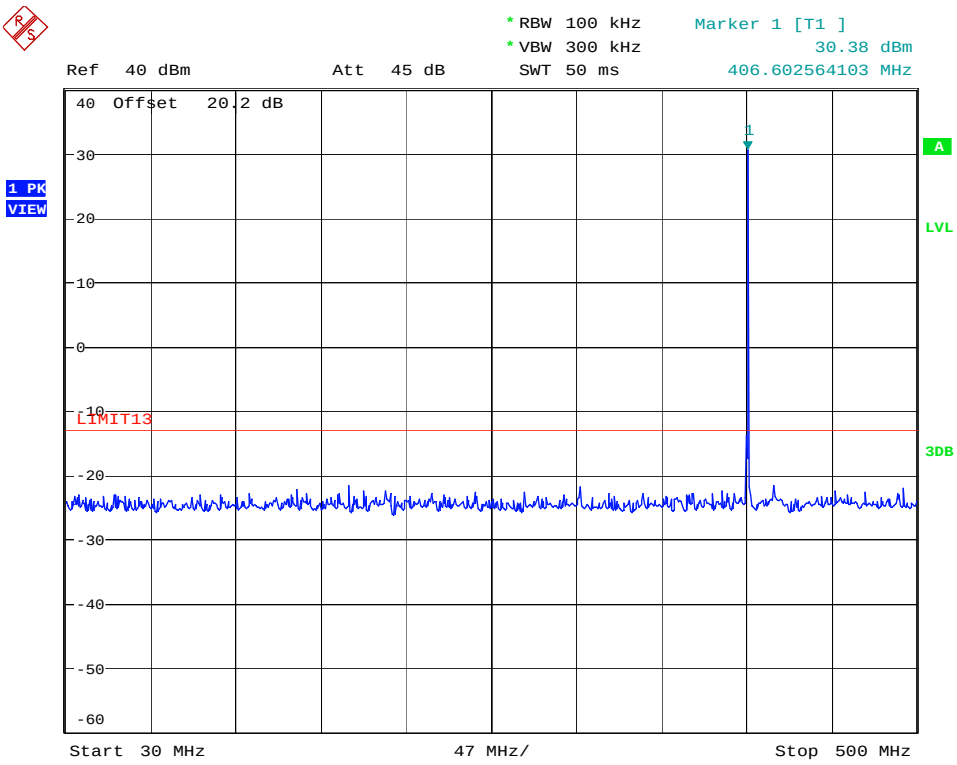
P1 = power in dBm, P2 = power in Watts

5.5.4. Test Arrangements



5.5.5. Test Data

5.5.5.1. Configuration: 406.2MHz, CW, Signal Input-0.2dB below AGC



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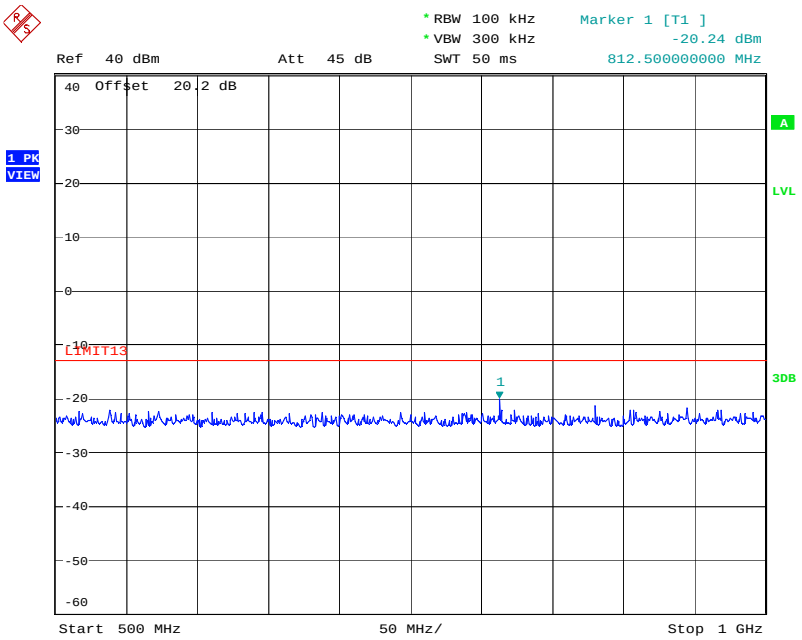

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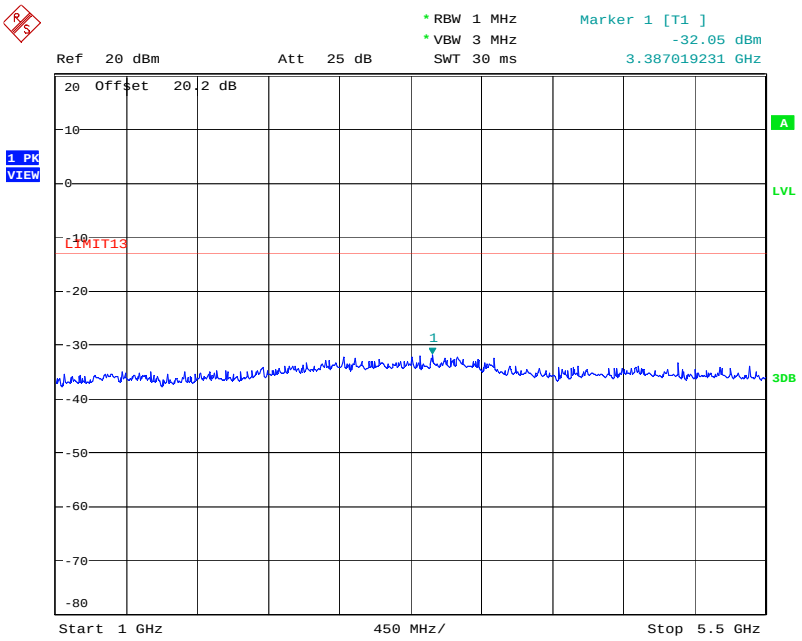

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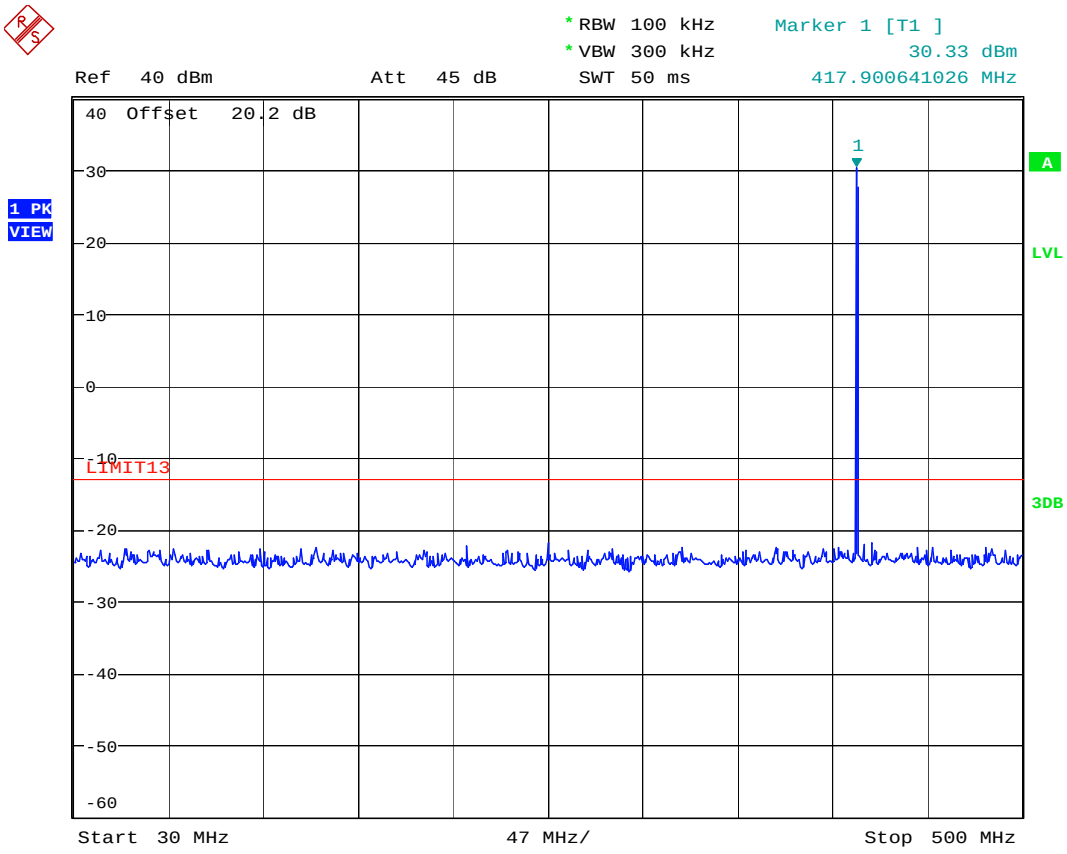
5.5.5.2. Configuration: 418MHz, CW, Signal Input-0.2dB below AGC



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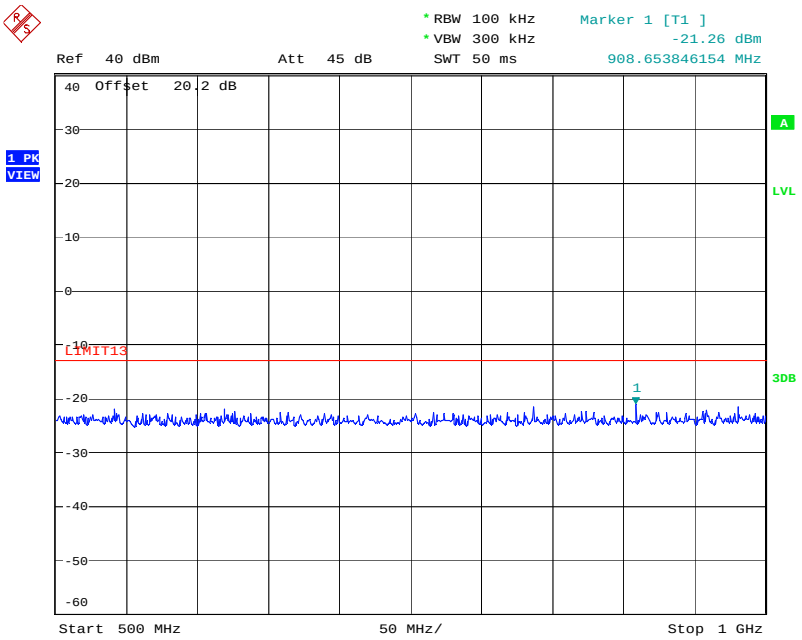

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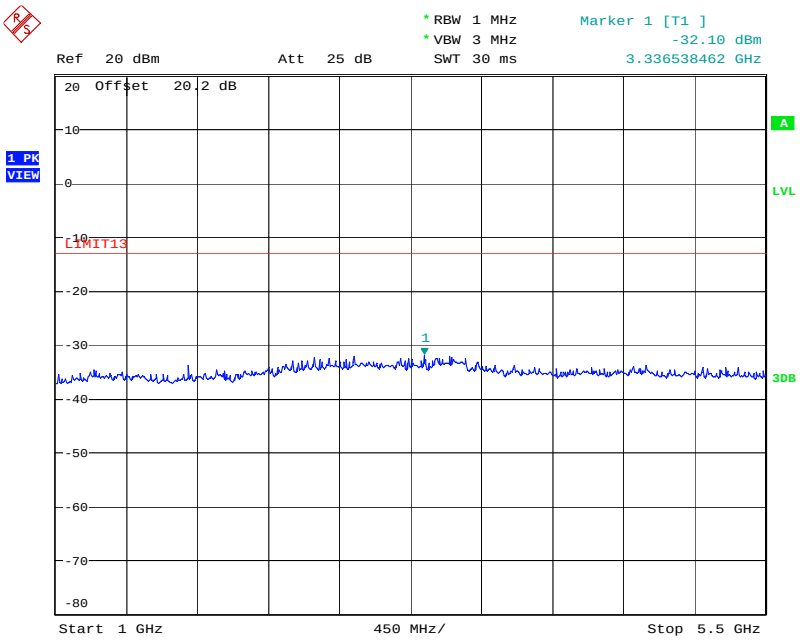

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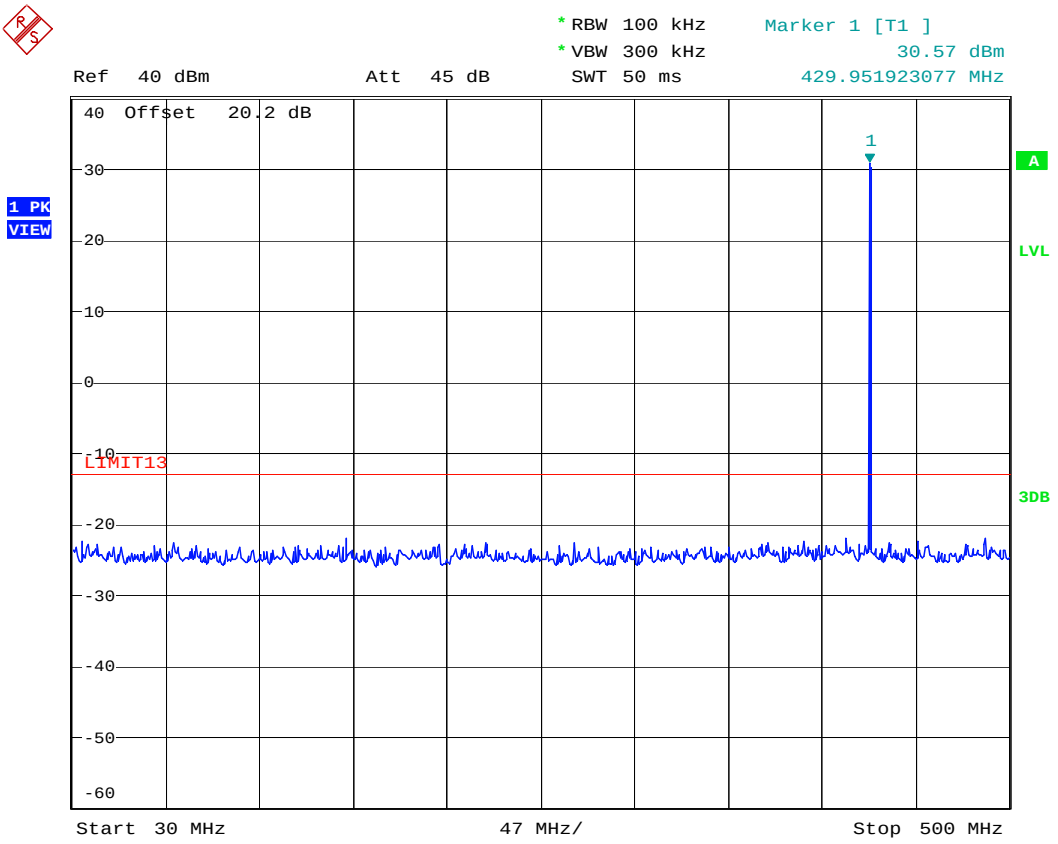
5.5.5.3. Configuration: 429.9MHz, CW, Signal Input-0.2dB below AGC



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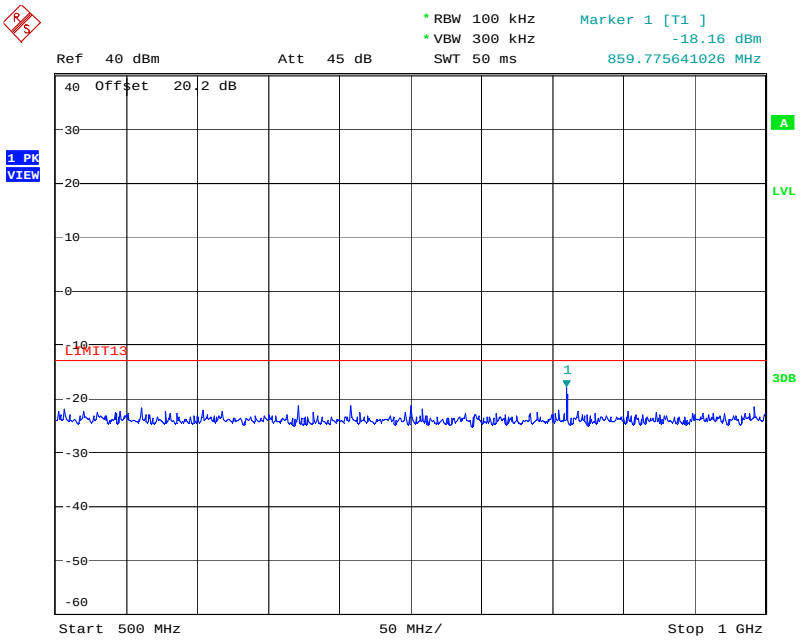

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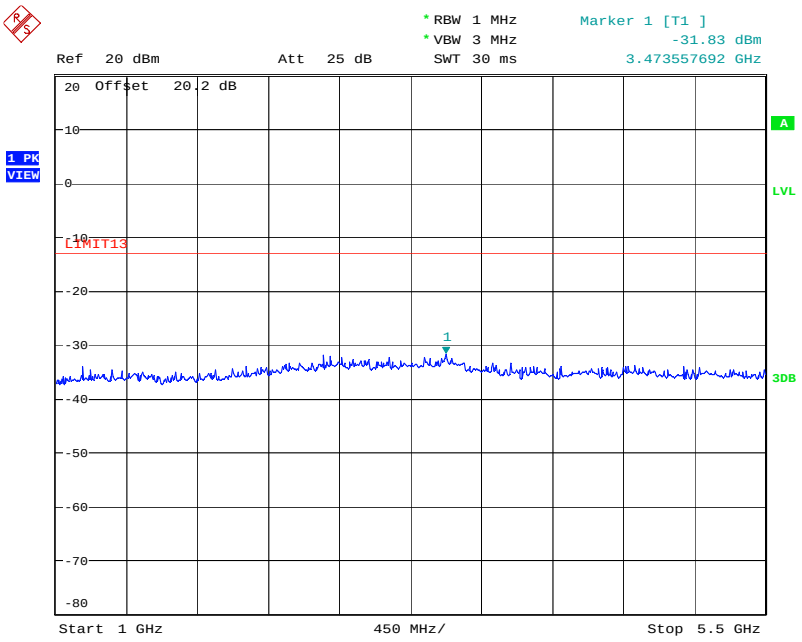

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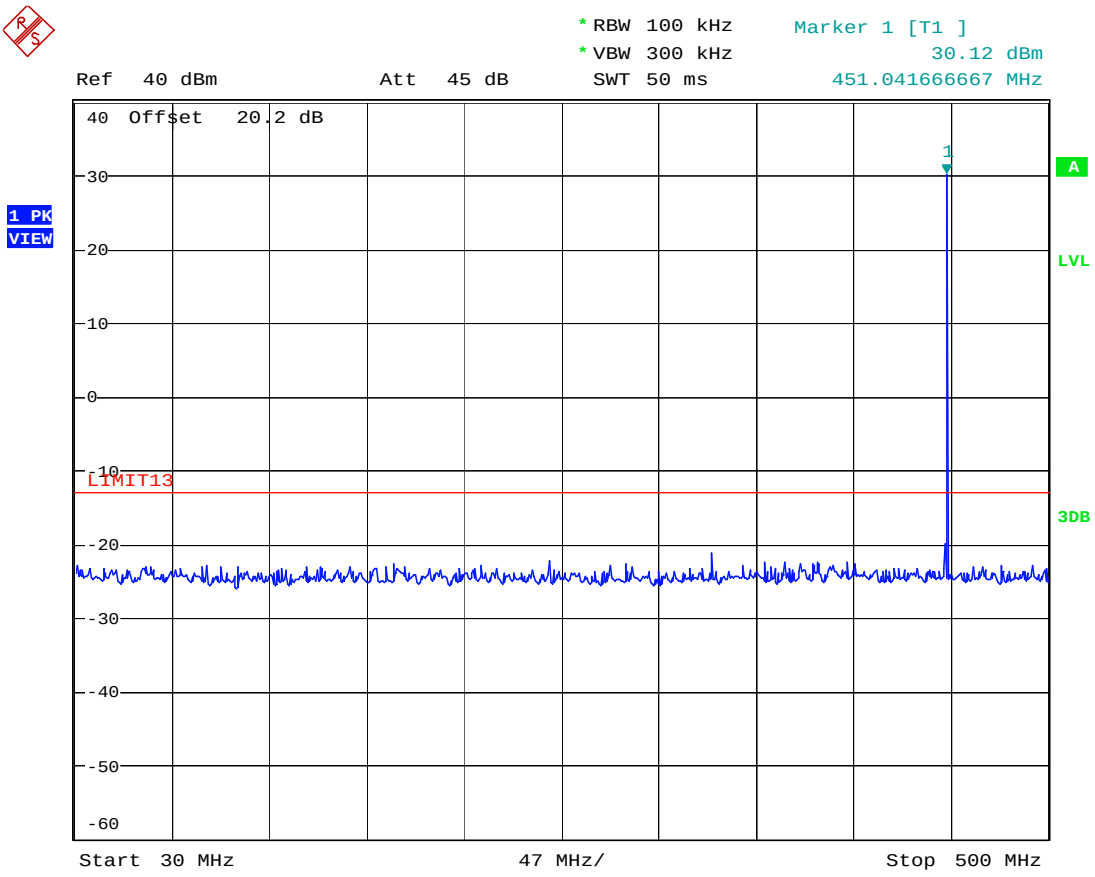
5.5.5.4. Configuration: 450.5MHz, CW, Signal Input-0.2dB below AGC



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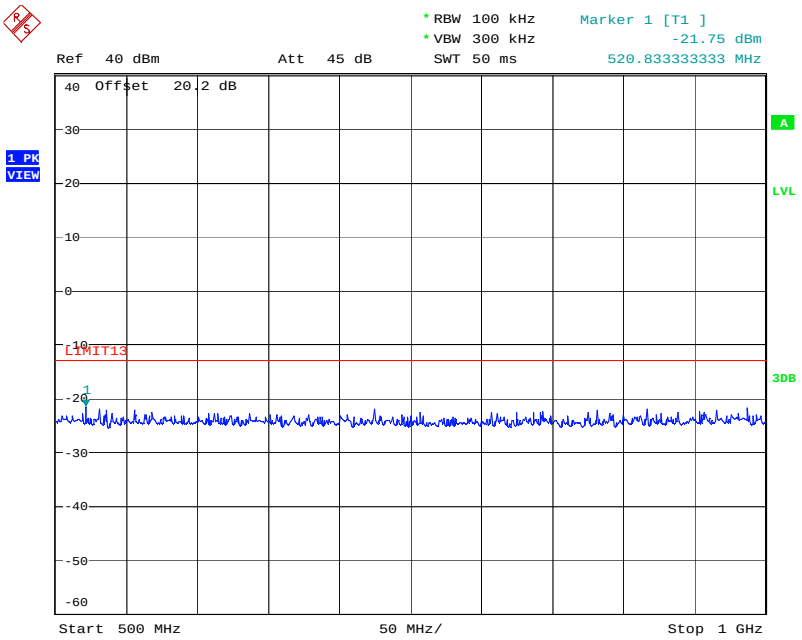

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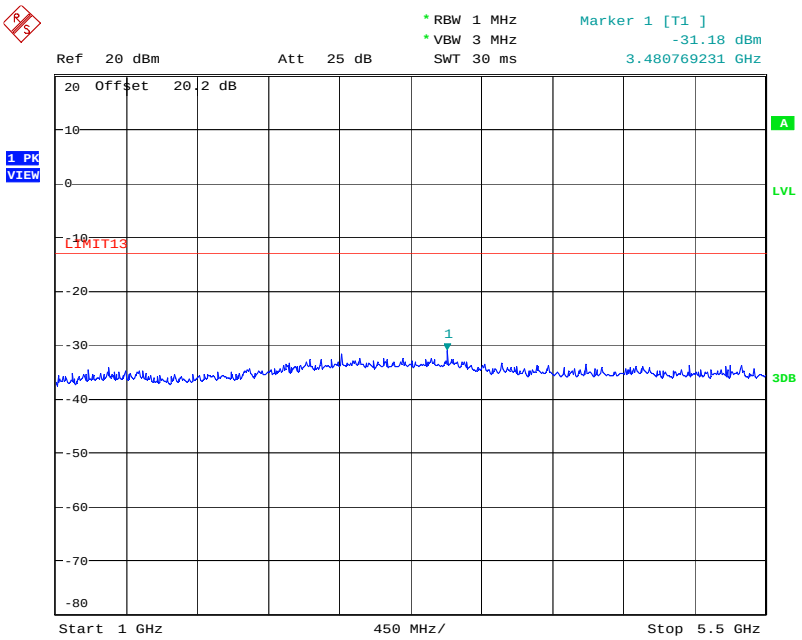

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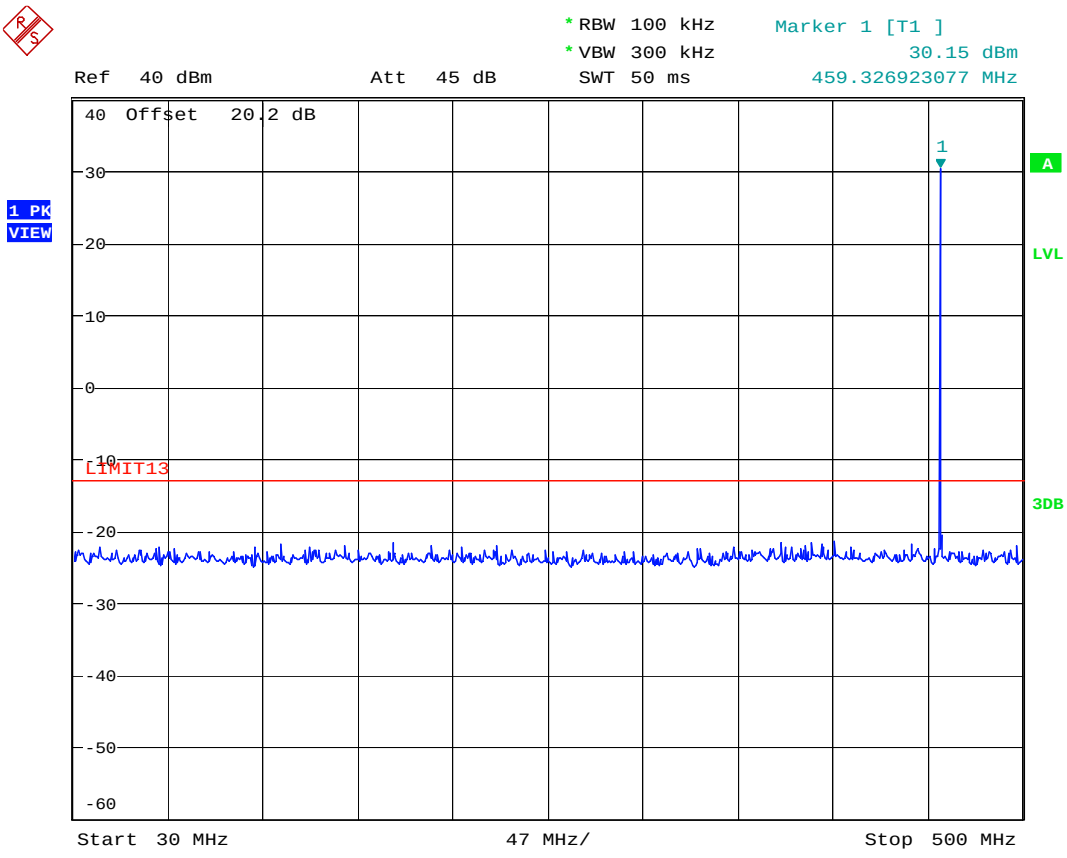
5.5.5.5. Configuration: 459MHz, CW, Signal Input-0.2dB below AGC



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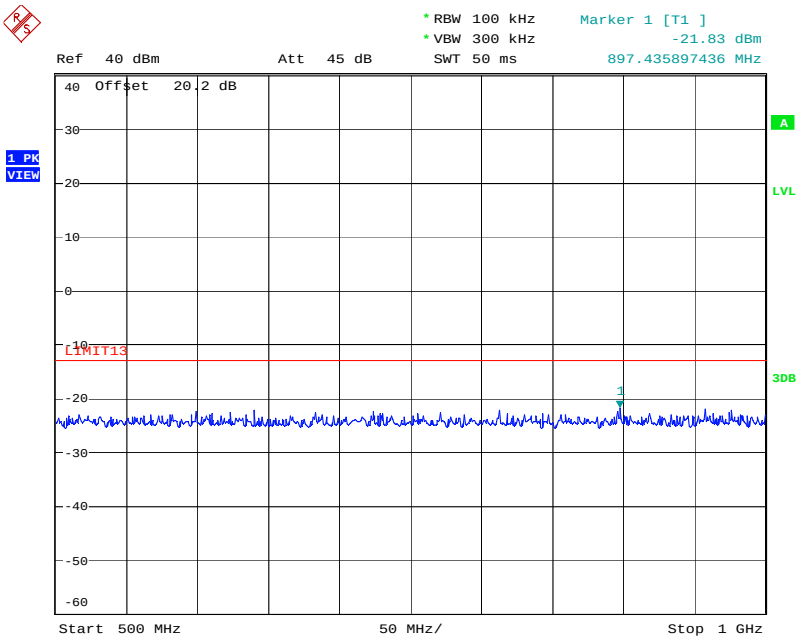

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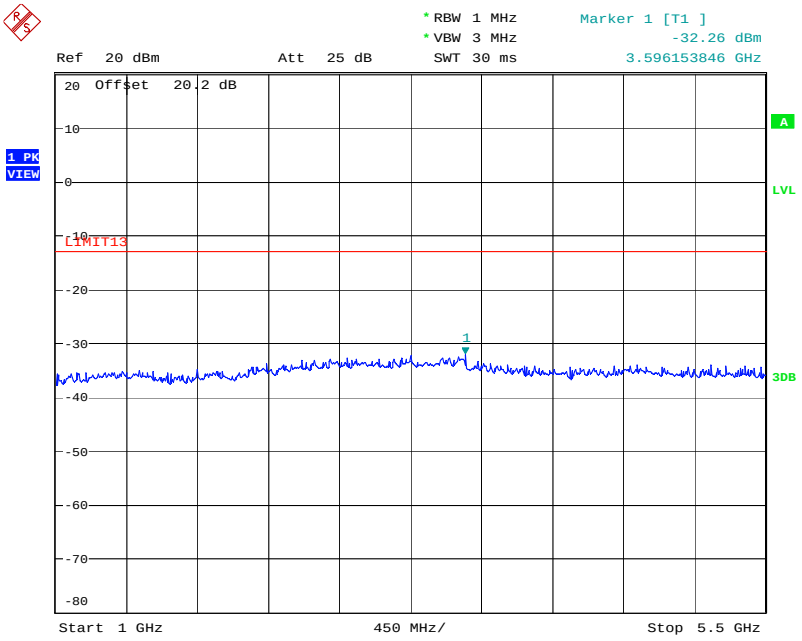
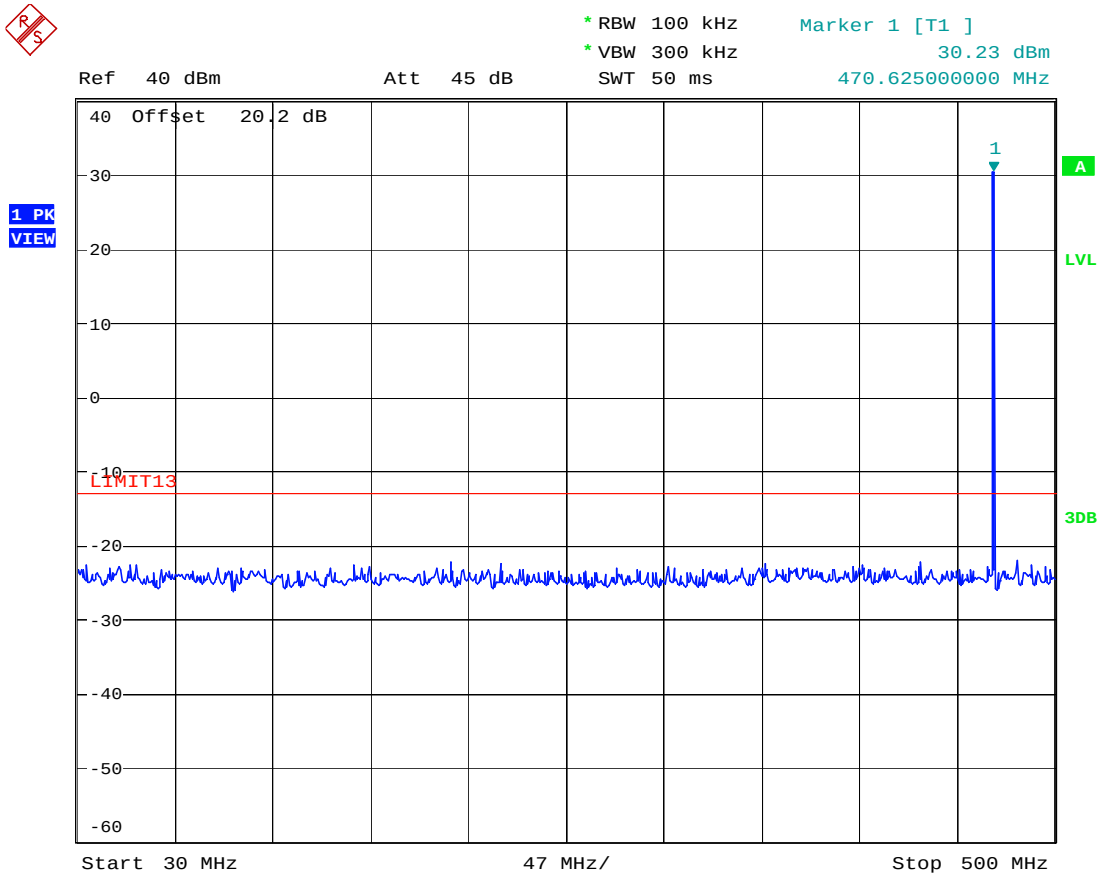


Date: 20.APR.2018 09:16:49

5.5.5.6. Configuration: 469.9MHz, CW, Signal Input-0.2dB below AGC



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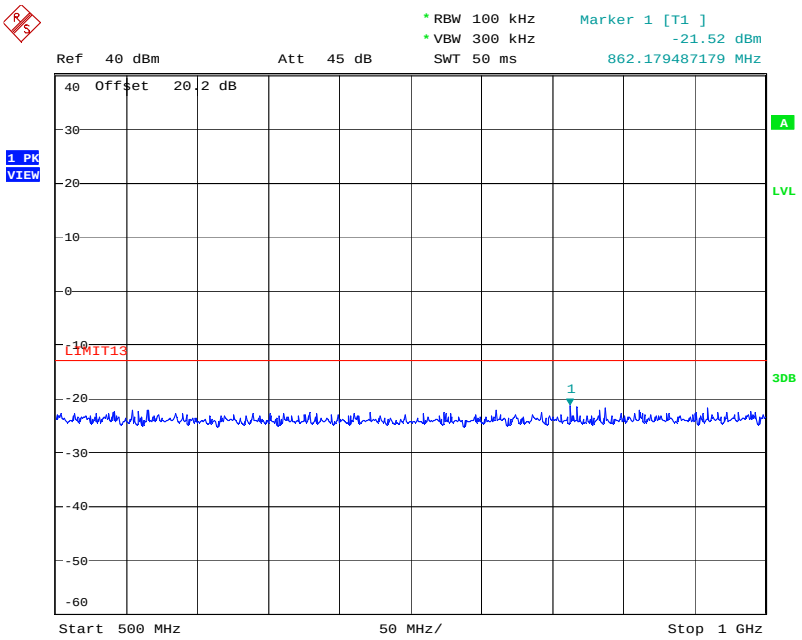

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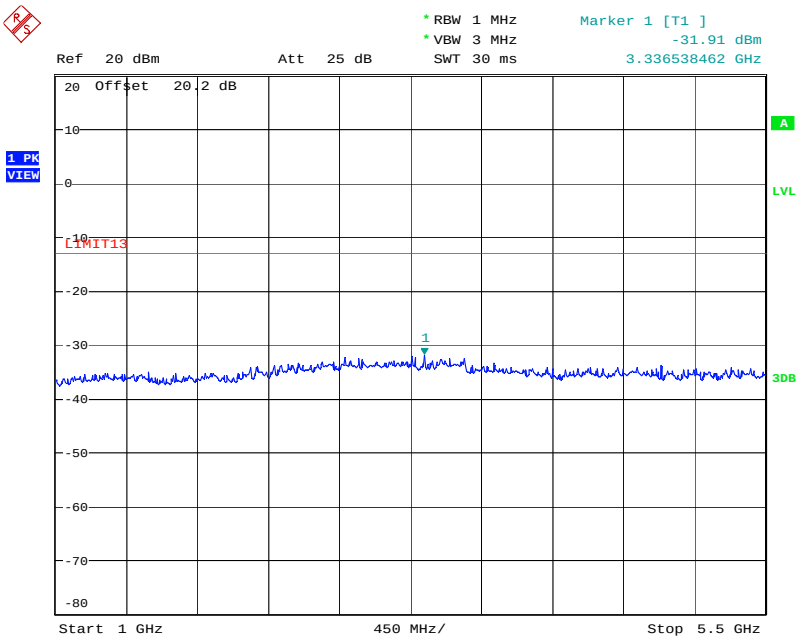
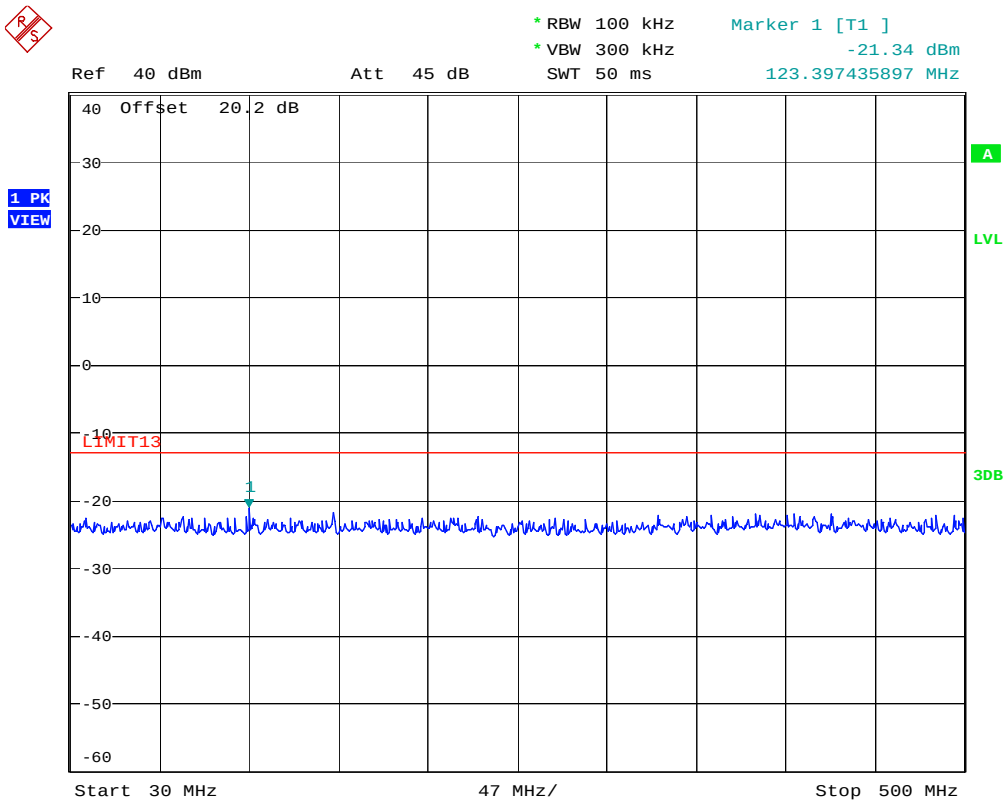
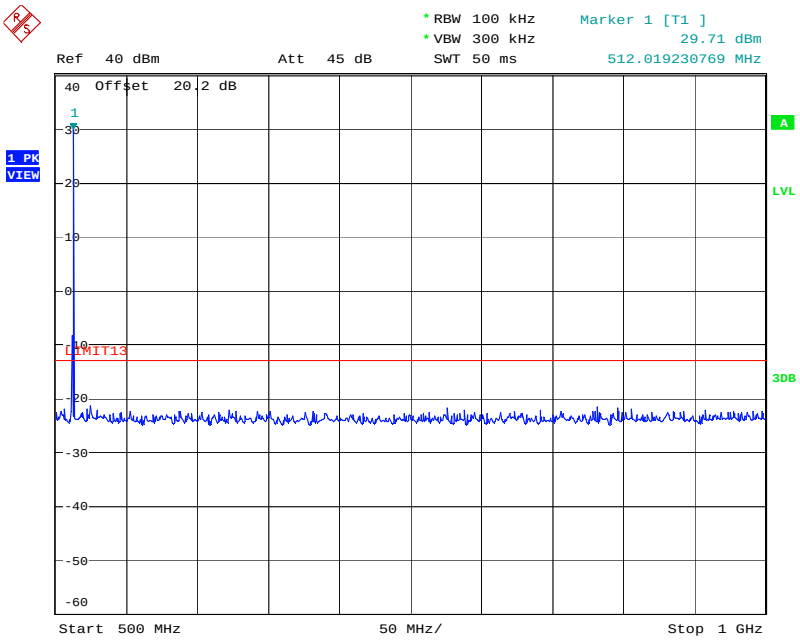


Date: 20.APR.2018 09:17:55

5.5.5.7. Configuration: 511.975MHz, CW, Signal Input-0.2dB below AGC





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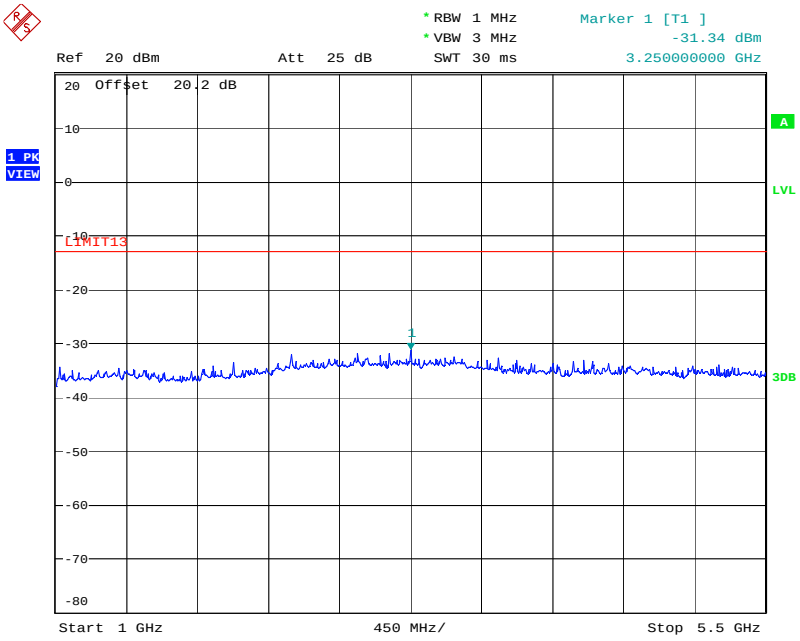


Date: 20.APR.2018 09:18:53

5.6. Radiated Spurious Emissions

5.6.1. Limits

§ 90.219 (c) Class A narrowband boosters must meet the out-of-band emission limits of § 90.210 for each narrowband channel that the booster is designed to amplify. Class B broadband signal boosters must meet the emission limits of § 90.210 for frequencies outside of the booster's designed pass band.

(e) (3) Spurious emissions from a signal booster must not exceed −13 dBm within any 100 kHz measurement bandwidth.

5.6.2. Measurement Procedure

The test shall be performed using substitution method specified in ANSI TIA-603-D-2010.

5.6.3. Test Procedure

The EUT was tested in a semi-anechoic chamber with the turntable set 3m from the receiving antenna. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Emissions. A signal generator was used to provide a CW signal. The EUT output was terminated into a 50ohm non-radiating load.

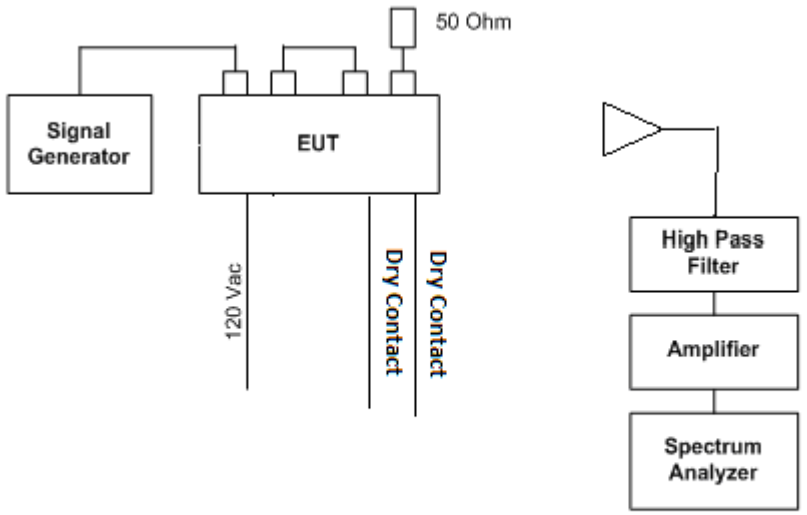
The RBW was set to 100 KHz for measurements below 1 GHz and 1 MHz for measurements above 1 GHz. The VBW was set to 3 times the RBW.

The following formula was used for calculating the limits.

Conducted Spurious Emissions Limit = P1-(43+10Log (P2)) = -13dBm

P1 = power in dBm, P2 = power in Watts

5.6.4. Test Arrangements



5.6.5. Test Data

Test Frequency: 406.2MHz

Frequency (MHz)	E-Field (dBuV/m)	EMI Detector (Peak/Qp/Avg)	Antenna Polarization(H/V)	ERP (dBm)	Limit (dBm)	Margin (dB)
30-6000	*	Peak	H/V	*	-13	*

* All harmonics and spurious emissions are more than 20dB below the specified attenuation limit.

Test Frequency: 429.9MHz

Frequency (MHz)	E-Field (dBuV/m)	EMI Detector (Peak/Qp/Avg)	Antenna Polarization(H/V)	ERP (dBm)	Limit (dBm)	Margin (dB)
30-6000	*	Peak	H/V	*	-13	*

* All harmonics and spurious emissions are more than 20dB below the specified attenuation limit.

Test Frequency: 450.5MHz

Frequency (MHz)	E-Field (dBuV/m)	EMI Detector (Peak/Qp/Avg)	Antenna Polarization(H/V)	ERP (dBm)	Limit (dBm)	Margin (dB)
30-6000	*	Peak	H/V	*	-13	*

* All harmonics and spurious emissions are more than 20dB below the specified attenuation limit.

Test Frequency: 459MHz

Frequency (MHz)	E-Field (dBuV/m)	EMI Detector (Peak/Qp/Avg)	Antenna Polarization(H/V)	ERP (dBm)	Limit (dBm)	Margin (dB)
30-6000	*	Peak	H/V	*	-13	*

* All harmonics and spurious emissions are more than 20dB below the specified attenuation limit.

Test Frequency: 469MHz

Frequency (MHz)	E-Field (dBuV/m)	EMI Detector (Peak/Qp/Avg)	Antenna Polarization(H/V)	ERP (dBm)	Limit (dBm)	Margin (dB)
30-6000	*	Peak	H/V	*	-13	*

* All harmonics and spurious emissions are more than 20dB below the specified attenuation limit.

Test Frequency: 511.975MHz

Frequency (MHz)	E-Field (dBuV/m)	EMI Detector (Peak/Qp/Avg)	Antenna Polarization(H/V)	ERP (dBm)	Limit (dBm)	Margin (dB)
30-6000	*	Peak	H/V	*	-13	*

* All harmonics and spurious emissions are more than 20dB below the specified attenuation limit.

5.7. Intermodulation

5.7.1. Limits

90.210 -Intermodulation products must be attenuated below the rated power of the EUT by at least 43 +10log (P), equivalent to -13 dBm.

5.7.2. Measurement Procedure

KDB 935210 Do5, ANSI C63.26 & FCC 90.210

5.7.3. Test Procedure

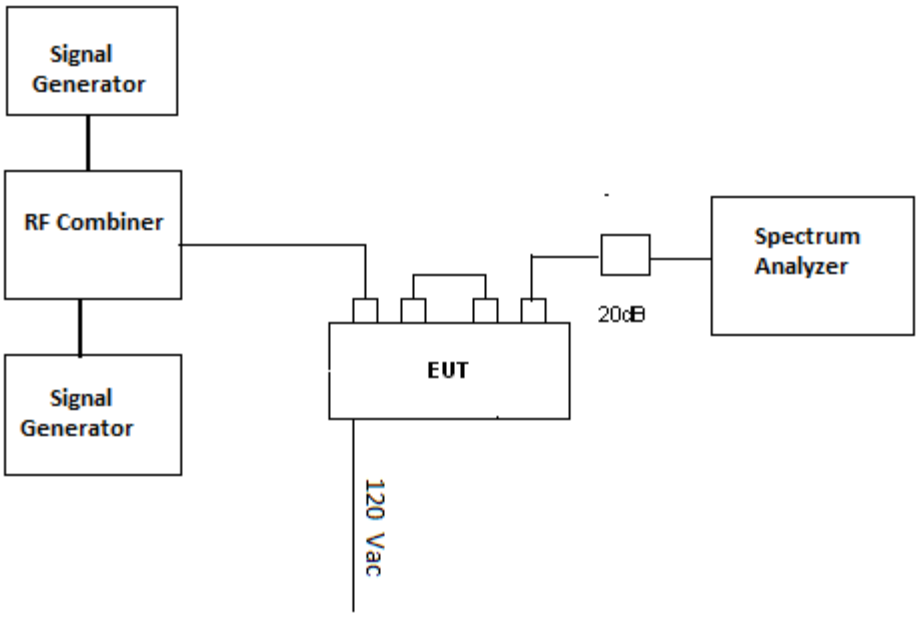
The EUT was connected to spectrum analyzer through a 20 dB attenuator. Two signal generators were utilized to produce a two tone signal with the 6.25, 12.5 and 25 KHz channel spacing set so the intermodulation products fell within the operational band.

The RF input signal level was set to 0.2 dB below the AGC threshold and again at 3dB above AGC threshold.

RBW = 300Hz

VBW = 3x RBW

5.7.4. Test Arrangements



5.7.5. Test Data

Channel Spacing	Test Frequency (MHz)	Worst case spurious level		Limit (dBm)	Compliance (YES/NO)
		@ Signal Input 0.2 dB below AGC (dBm)	@ Signal Input 3 dB below AGC (dBm)		
6.25 kHz	406.2	-13.17	-13.29	-13	YES
	418	**-13.09**	-13.13	-13	YES
	429.9	-13.12	-13.35	-13	YES
	450.5	-13.13	-13.14	-13	YES
	459	-13.12	-13.23	-13	YES
	469	-13.12	-13.31	-13	YES
	511.975	-13.12	-14.27	-13	YES
12.5 kHz	406.2	-13.49	-18.30	-13	YES
	418	-13.22	-13.14	-13	YES
	429.9	-13.30	-13.11	-13	YES
	450.5	-13.10	-13.21	-13	YES
	459	-13.19	-13.33	-13	YES
	469	-14.62	-14.60	-13	YES
	511.975	-15.42	-20.40	-13	YES
25 kHz	406.2	-18.33	-17.86	-13	YES
	418	-16.75	-15.82	-13	YES
	429.9	-13.19	-13.29	-13	YES
	450.5	-13.86	-13.90	-13	YES
	459	-16.19	-16.13	-13	YES
	469	-19.51	-19.89	-13	YES
	511.975	-20.30	-20.82	-13	YES

Refer to Annex B for Intermodulation Plots

5.8. Noise Figure

5.8.1. Limits

90.219 (e)(2), the noise figure of a signal booster must not exceed 9 dB in either direction.

5.8.2. Measurement Procedure

KDB 935210 Do5, ANSI C63.26, 90.219

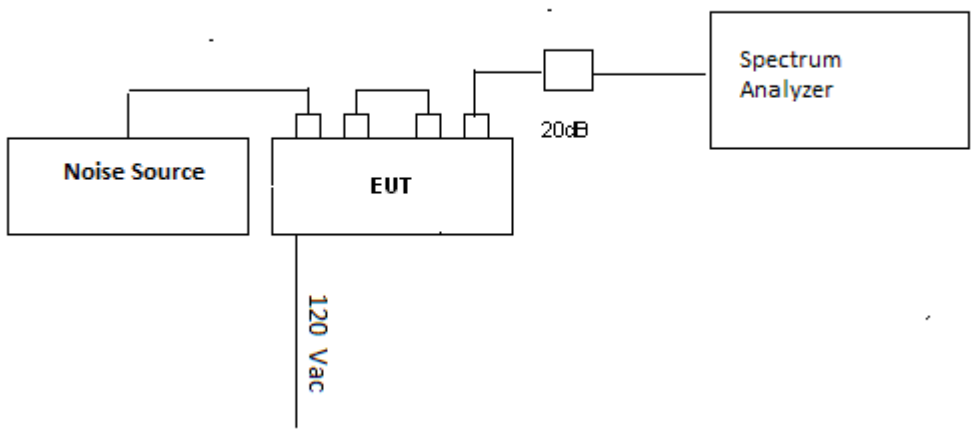
5.8.3. Test Procedure

The test equipment was connected as shown in the test setup.

The noise figure was measured at all test frequency

Detailed measurement steps followed from Rhohde & Schwarz Document -The Y factor Technique for Noise Figure Measurements

5.8.4. Test Arrangements



5.8.5. Test Data

Frequency (MHz)	Calibration Step		Measurement Step		Noise Figure	Limit (dB)
	Noise Source OFF (dBm)	Noise Source ON (dBm)	Noise Source OFF (dBm)	Noise Source ON (dBm)		
406.2	-76.52	-76.34	-41.55	-30.18	2.00	9
418	-76.56	-76.43	-41.77	-30.56	2.17	9
429.9	-76.48	-76.53	-42.36	-30.94	1.94	9
450.5	-76.54	-76.6	-43.31	-31.98	2.04	9
459	-76.64	-76.63	-43.42	-32.26	2.22	9
469.9	-76.62	-76.59	-43.28	-32.28	2.40	9
511.975	-76.79	-76.7	-43.23	-31.86	2.00	9

EXHIBIT 6. RF EXPOSURE REQUIRMENTS [§§ 1.1310 & 2.1091]

The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation.

FCC 47 CFR § 1.1310:

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*($900/f^2$)	6
30–300	61.4	0.163	1.0	6
300–1500	.....	.....	f/300	6
1500–100,000	.....	.....	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*($180/f^2$)	30
30–300	27.5	0.073	0.2	30
300–1500	.....	.....	f/1500	30
1500–100,000	.....	.....	1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

6.1.1. Method of Measurements

Refer to Sections 1.1310, 2.1091

In order to demonstrate compliance with MPE requirements (see Section 2.1091), the following information is typically needed:

(1) Calculation that estimates the minimum separation distance (20 cm or more) between an antenna and persons required to satisfy power density limits defined for free space.
(2) Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement
(3) Any caution statements and/or warning labels that are necessary in order to comply with the exposure limits
(4) Any other RF exposure related issues that may affect MPE compliance

Calculation Method of RF Safety Distance:

$$S = \frac{P \cdot G}{4 \cdot \pi \cdot r^2} = \frac{EIRP}{4 \cdot \pi \cdot r^2}$$

Where: P: power input to the antenna in mW
EIRP: Equivalent (effective) isotropic radiated power
S: power density mW/cm^2
G: numeric gain of antenna relative to isotropic radiator
r: distance to centre of radiation in cm

6.1.2. RF Evaluation

EVALUATION OF RF EXPOSURE COMPLIANCE REQUIREMENTS	
RF Exposure Requirements	**Compliance with FCC Rules**
Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement	Antenna installation and device operating instructions shall be provided to installers to maintain and ensure compliance with RF exposure requirements.
Caution statements and/or warning labels that are necessary in order to comply with the exposure limits	Refer to User's Manual for RF Exposure Information.

*The minimum separation distance between the antenna and bodies of users are calculated using the following formula:

$$r = \sqrt{\frac{P \cdot G}{4 \cdot \pi \cdot S}} = \sqrt{\frac{EIRP}{4 \cdot \pi \cdot S}}$$

6.1.3. RF Evaluation

Distance specified in user manual=38 cm

Frequency (MHz)	Max. Conducted Power (dBm)	Max. Antenna Gain (dBi)	EIRP (dBm)	EIRP (mW)	Evaluation Distance, r (cm)	Power Density, S (mW/cm^2)	MPE Limit (mW/cm2)
406.1	31.69	2.15	33.84	2421	38	0.133	0.271

EXHIBIT 7. TEST EQUIPMENT LIST

Test Instrument	Manufacturer	Model No	Serial No	Frequency Range	Cal Due date
Power Meter	HP	436A	2016A07747	100KHz-sensor dependant	08 May 2018
Power Sensor	HP	8482A	MY41172054	10MHz-18GHz	26 Oct 2019
Attenuator	Weinschel	46-20-34	BS5681	DC-18GHz	14 Oct 2018
Signal Generator	Marconi	2024	112255/164	9KHz-2.4GHz	16 Aug 2018
Spectrum Analyzer	Rohde & Schwarz	FSU	100398	20Hz-26.5GHz	06 Oct 2019
Vector Signal Generator	Rohde & Schwarz	SMJ 100A	100644	100KHz-6GHz	19 Oct 2018
Signal Generator	IFR	2025	202304/137	9KHz-2.5GHz	07 Feb 2019
RF Combiner	Mini-Circuit	15542	ZFSC-3-4	1MHz-1GHz	Cal on use
Noise source	Hewlett Packard	346C	…	10MHz-26.5GHz	Cal on Use
Bicon Antenna	ETS	3110B	3379	30-200MHz	06 Feb 2020
Log Periodic Antenna	ETS	3148	00023845	200-2000MHz	20 Jul 2018
Horn Antenna	ETS	3117	00119425	1-18GHz	29 Jun 2019
Preamplifier	Com-Power	PAM-118A	551016	500MHz-18GHz	09 Mar 2019
Preamplifier	Com-Power	PA-103	161040	1-1000MHz	05 Jun 2018
Hi-pass filter	Mini-Circuit	SHP-600	--	Cut off 560MHz	Cal on use
Hi-pass filter	Mini-Circuit	SHP-800	--	Cut off 800MHz	Cal on use

Note: All tests for this device was completed on Apr 20, 2018

EXHIBIT 8. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of CISPR 16-4-2 @ IEC:2003 and JCGM 100:2008 (GUM 1995) – Guide to the Expression of Uncertainty in Measurement.

8.1. LINE CONDUCTED EMISSION MEASUREMENT UNCERTAINTY

	Line Conducted Emission Measurement Uncertainty (150 kHz – 30 MHz):	**Measured**	**Limit**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$	**± 1.57**	**± 1.8**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 3.14**	**± 3.6**

8.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY

	Radiated Emission Measurement Uncertainty @ 3m, Horizontal (30-1000 MHz):	**Measured**	**Limit**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$	**± 2.15**	**± 2.6**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 4.30**	**± 5.2**

	Radiated Emission Measurement Uncertainty @ 3m, Vertical (30-1000 MHz):	**Measured**	**Limit**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$	**± 2.39**	**± 2.6**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 4.78**	**± 5.2**

	Radiated Emission Measurement Uncertainty @ 3 m, Horizontal & Vertical (1 – 18 GHz):	**Measured**	**Limit**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$	**± 1.87**	Under consideration
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 3.75**	Under consideration