# ENGINEERING TEST REPORT

## Bi-Directional Amplifier System
## Model: BDA138174
## FCC ID: WDM-BDA138174

*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.: 18CMPR026Q_FCC90**

| | |
|---|---|
| This Test report is Issued under the Authority of<br>Tri M. Luu<br>Vice President of Engineering<br>UltraTech Group of Labs<br><br>Date: May 23, 2018 | |
| Report Prepared by:<br><br>Santhosh Fernandez<br><br>Issued Date: May 23, 2018 | Tested by: Hung Trinh<br><br>Test Dates: Apr 19- May 09, 2018 |

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APEC TEL #CA0001 | **1309** | CA 0001/2049 | **AT-1945** | **SL2-IN-E-1119R** | **Korea KCC-RRA** **CA2049**

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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 150-174 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 |
| 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<br>Orchard Park, NY 14127<br>USA |
| **Contact Person:** | Mr. Fernando Apolinario<br>Phone #: 450-641-1454<br>Fax #: 450-641-4616<br>Email Address: fapolinario@comprodcom.com |

| **MANUFACTURER** | |
|---|---|
| **Name:** | Comprod Communications Ltd |
| **Address:** | 88 Boulevard Industriel<br>Boucherville, Quebec<br>Canada J4B 2X2 |
| **Contact Person:** | Mr. Fernando Apolinario<br>Phone #: 450-641-1454, Ext.106<br>Fax #: 450-641-4616<br>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:** | BDA138174 |
| **Serial Number:** | 8F40308 |
| **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):** | 30 dBm or 1.0Watts |
| **Operating Frequency Range:** | 150.05-173.4 MHz |
| **Channel Spacing:** | 6.25 kHz, 12.5 kHz & 25 kHz |
| **RF Input/Output Impedance:** | 50 Ohm |
| **Maximum Gain specification:** | 75 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:** | Same as Transmitter |

## 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 |

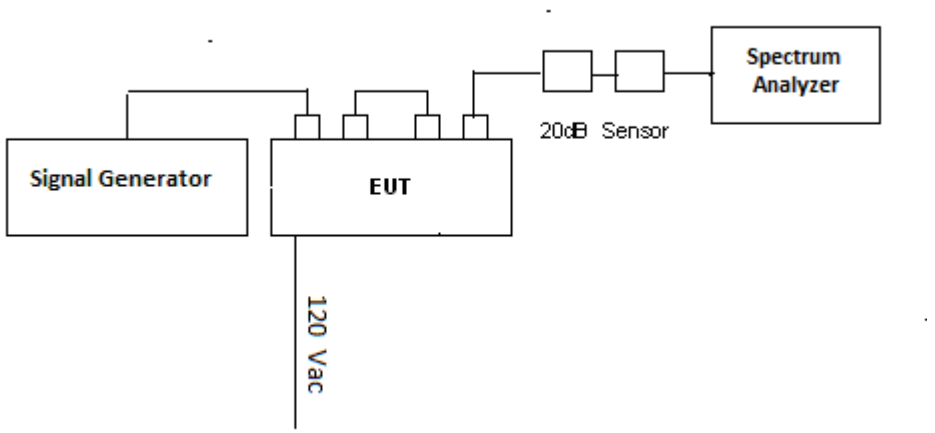
## 2.5. ASSOCIATED EQUIPMENT

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$^{o}$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):** | 150.05-173.4 MHz |
| **Frequency(ies) Tested:**<br>(Near lowest, near middle & near highest frequencies in the frequency range of operation.) | 150.1 MHz, 157.2 MHz, 173.3 MHz |
| **Transmitter Wanted Output Test Signals:** | |
| Transmitter Power (measured maximum output power): | 29.12dBm |
| Normal Test Modulation: | F3E, F1D (Analog & Digital) |
| Modulating signal source: | 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-200+) 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, P/N: 28A5776-0A2 with two turns) 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

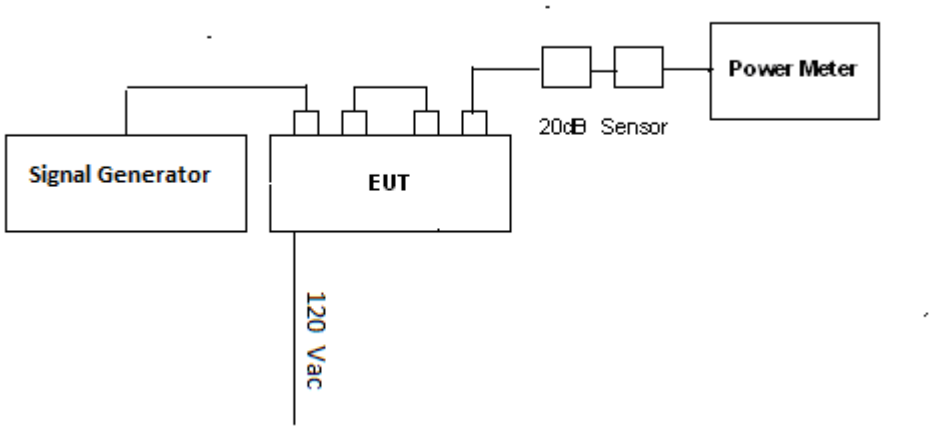
### 5.1.1. Method of Measurements

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) |
|---|---|---|
| 150.1 | -44.67 | 28.73 |
| 157.2 | -44.90 | 28.78 |
| 173.3 | -44.54 | 29.12 |

## 5.2. Out of Band Rejection

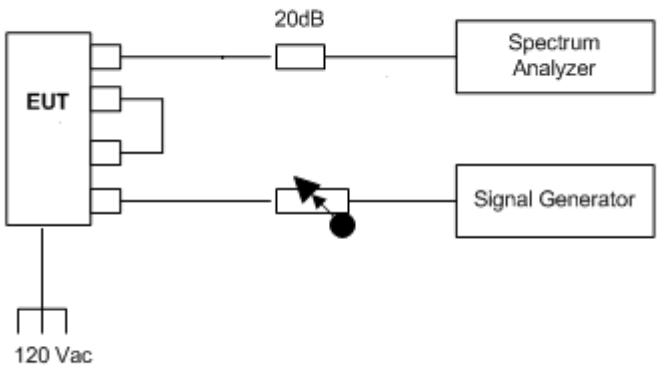
### 5.2.1. Method of Measurements

KDB 935210 D05 and ANSI C63.26

### 5.2.2. Test Procedure

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.

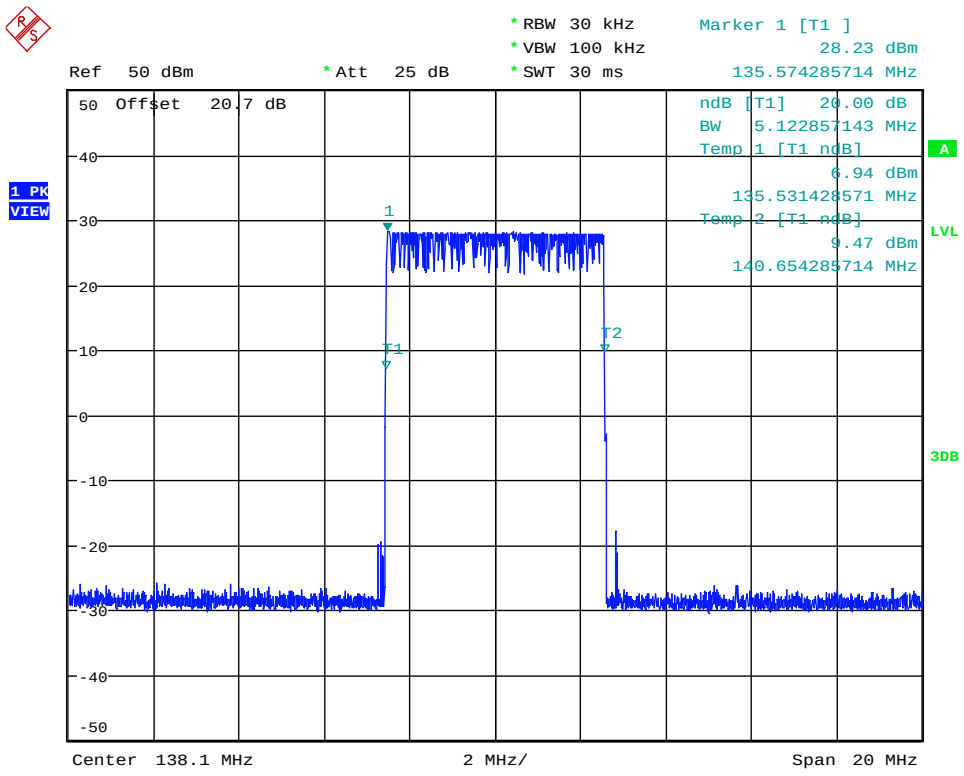
### 5.2.3. Test Arrangements



### 5.2.4. Test Data

Configuration: 138.1MHz, CW, Signal Input 3dB below AGC
+/- 250% of Pass Band: 1 MHz = +/- 2.5 MHz

BW measured: 5.12 MHz

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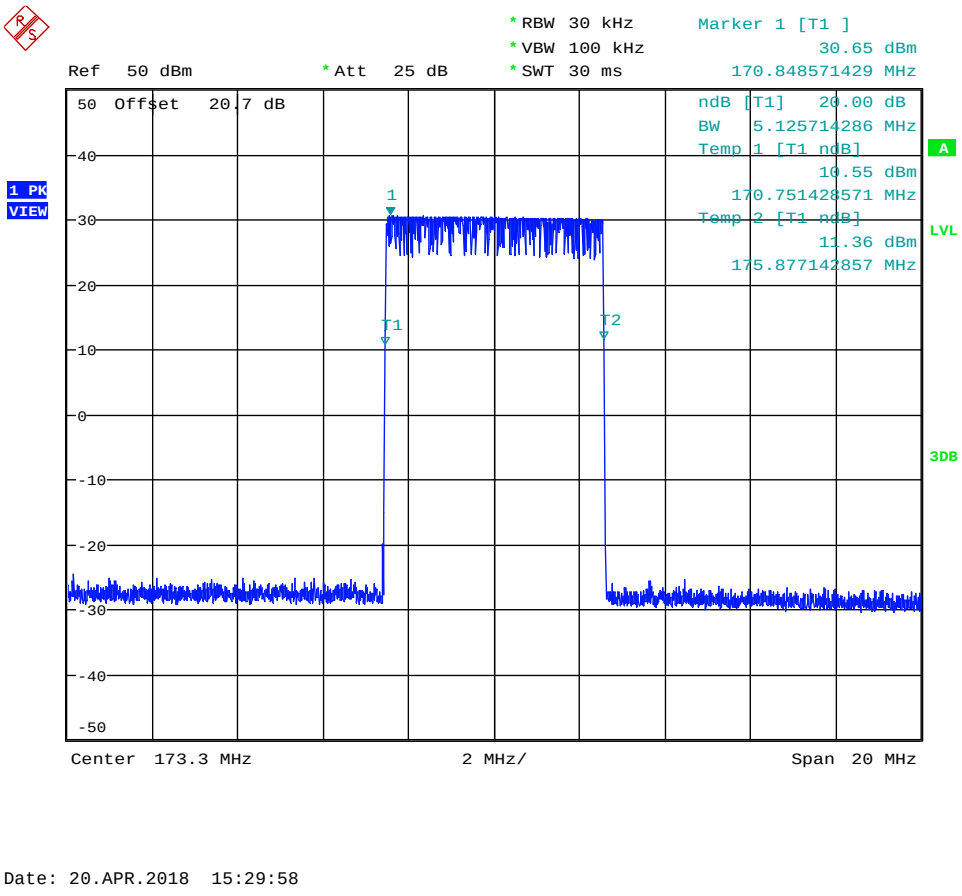
Configuration: 173.3 MHz, CW, Signal Input 3dB below AGC

BW measured: 5.13 MHz




Note: Above are sample plots with signal input of +/- 2.5 MHz with a 1 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

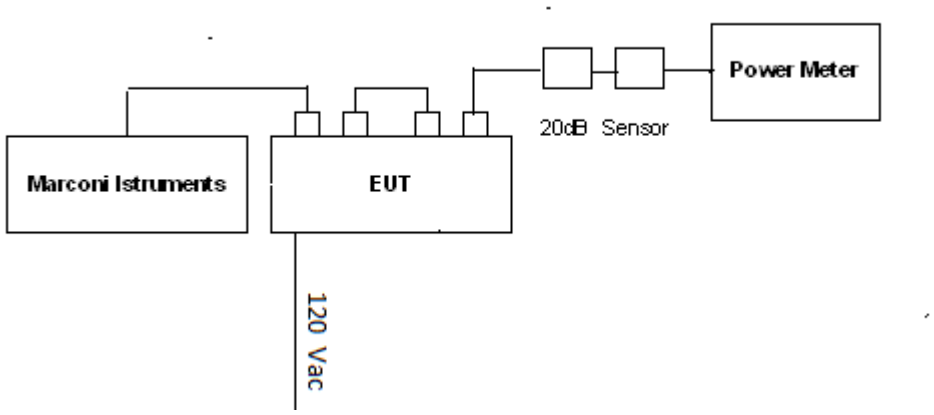
KDB 935210 Do5, ANSI C63.26

### 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) | Output Power (dBm) | Gain (dB) | Rated Power (dBm) | Power Limit (dBm) |
|---|---|---|---|---|---|
| *138.1 | -46.66 | 28.68 | 75.34 | 30.00 | 37 |
| *148.1 | -45.74 | 28.57 | 74.31 | 30.00 | 37 |
| 150.1 | -44.93 | 28.56 | 73.49 | 30.00 | 37 |
| 157.2 | -45.26 | 28.62 | 73.88 | 30.00 | 37 |
| 173.3 | -44.82 | 28.90 | 73.72 | 30.00 | 37 |

*** Note- This test results are "Not applicable for FCC Certification" purpose.**

## 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 D05, C63.26

### 5.4.3. Test Procedure

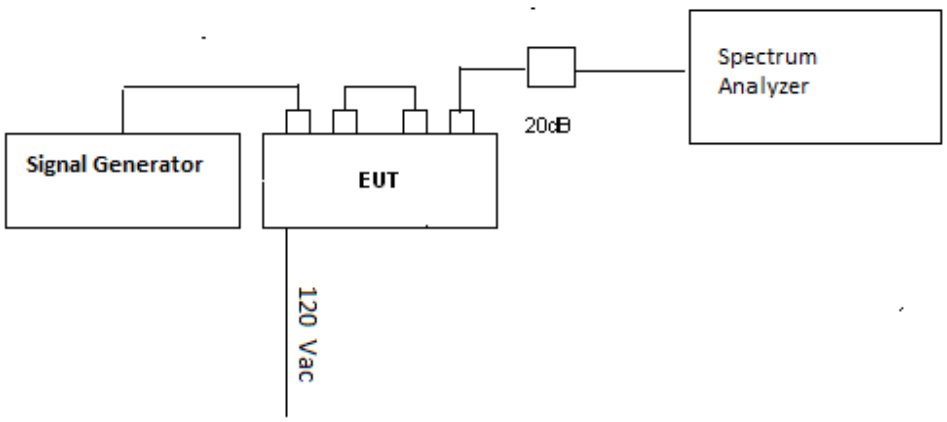
The EUT was connected directly to a spectrum analyzer to verify that the EUT meets the required emissions mask. The EUT is a booster amplifier that does not contain a transmitter; representative emission designators used in the industry were used for the emission masks and are listed in Table below:

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|
| 138.1* | 3.88 | 3.77 | 6.79 | 6.86 | 4.04 | 4.04 | 7.93 | 7.93 | 12.44 | 12.44 |
| 148.1* | 3.67 | 3.78 | 6.83 | 6.73 | 4.04 | 4.04 | 7.93 | 7.93 | 12.44 | 12.44 |
| 150.1 | 3.62 | 3.67 | 6.86 | 6.79 | 4.06 | 4.06 | 7.93 | 7.93 | 12.37 | 12.37 |
| 157.2 | 3.81 | 3.72 | 6.69 | 6.92 | 4.04 | 4.04 | 7.93 | 7.93 | 12.44 | 12.44 |
| 173.3 | 3.65 | 3.88 | 6.83 | 6.73 | 4.04 | 4.04 | 7.93 | 7.93 | 12.44 | 12.44 |

*** Note- This test results are "Not applicable for FCC Certification" purpose.**

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) |
|---|---|---|---|---|---|---|---|---|---|---|
| 138.1* | 3.69 | 3.72 | 6.83 | 6.73 | 4.04 | 4.04 | 7.93 | 7.93 | 12.44 | 12.44 |
| 148.1* | 3.69 | 3.75 | 6.89 | 6.70 | 4.04 | 4.04 | 7.93 | 7.93 | 12.44 | 12.44 |
| 150.1 | 3.62 | 3.79 | 6.76 | 6.86 | 4.06 | 4.06 | 7.93 | 7.93 | 12.37 | 12.37 |
| 157.2 | 3.67 | 3.64 | 6.79 | 6.83 | 4.04 | 4.04 | 7.93 | 7.93 | 12.44 | 12.44 |
| 173.3 | 3.75 | 3.72 | 6.57 | 6.76 | 4.04 | 4.04 | 7.93 | 7.93 | 12.44 | 12.44 |

*** Note- This test results are "Not applicable for FCC Certification" purpose.**

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.

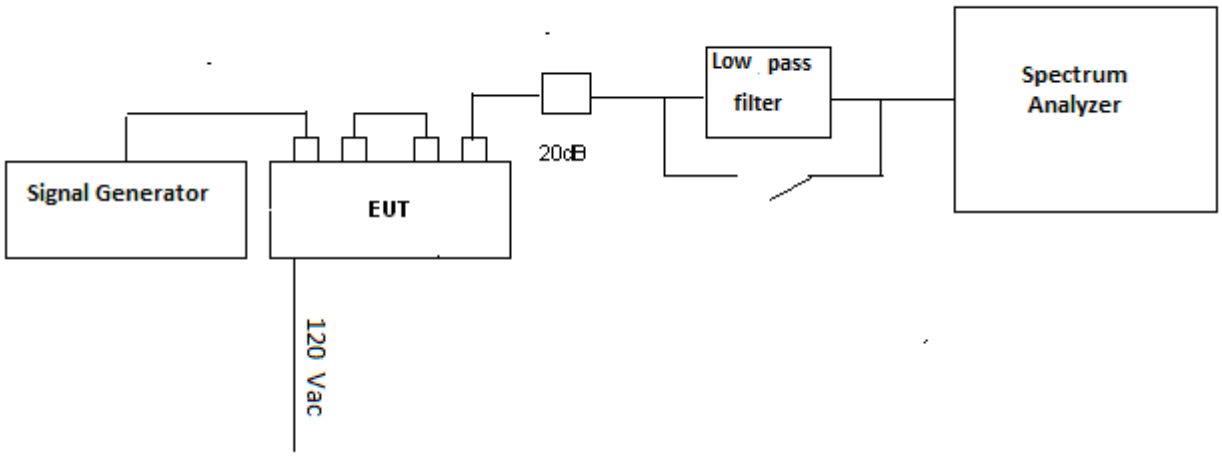
The frequency range fro, 30 MHz to the 10th harmonic of the pass band frequency was observed and plotted.

The following formula was used for calculating the limits.

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

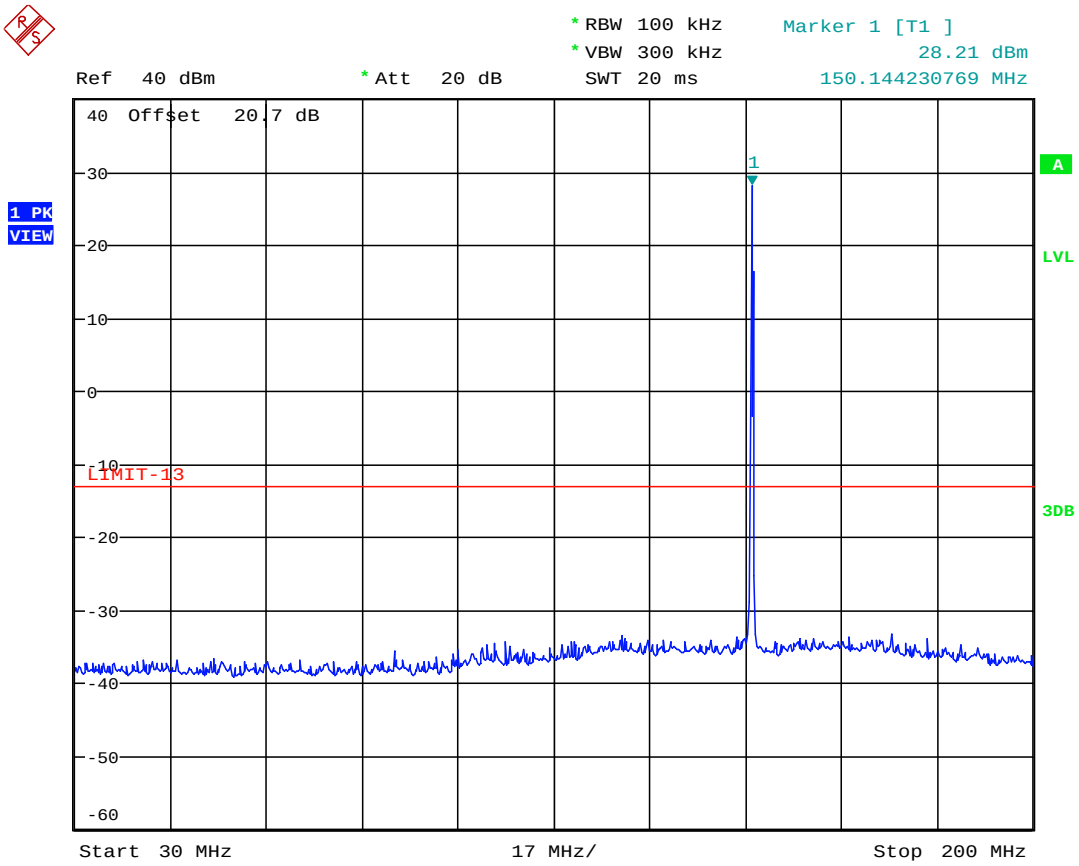
P1 = power in dBm, P2 = power in Watts

### 5.5.4. Test Arrangements

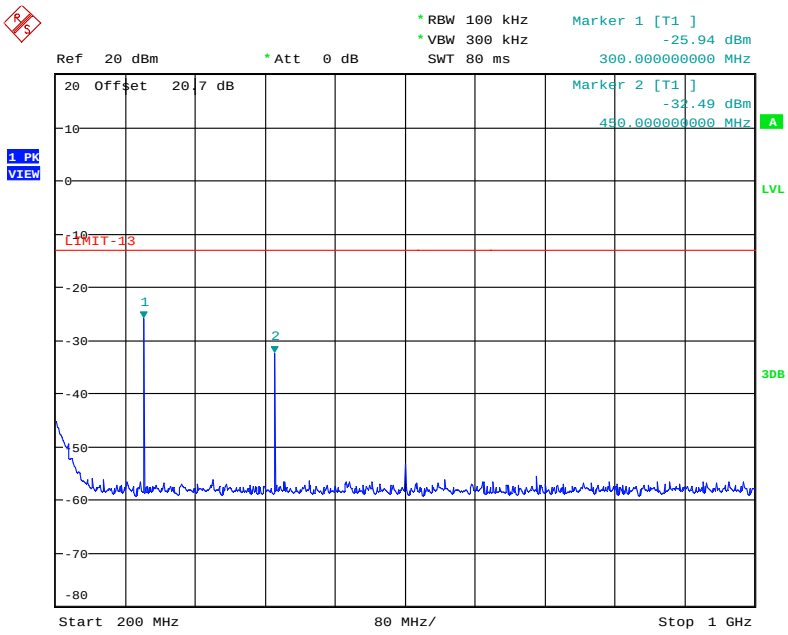


## 5.5.5. Test Data

### 5.5.5.1. Configuration: 150.1MHz, CW, Signal Input-0.2dB below AGC




Date: 8.MAY.2018 11:14:29

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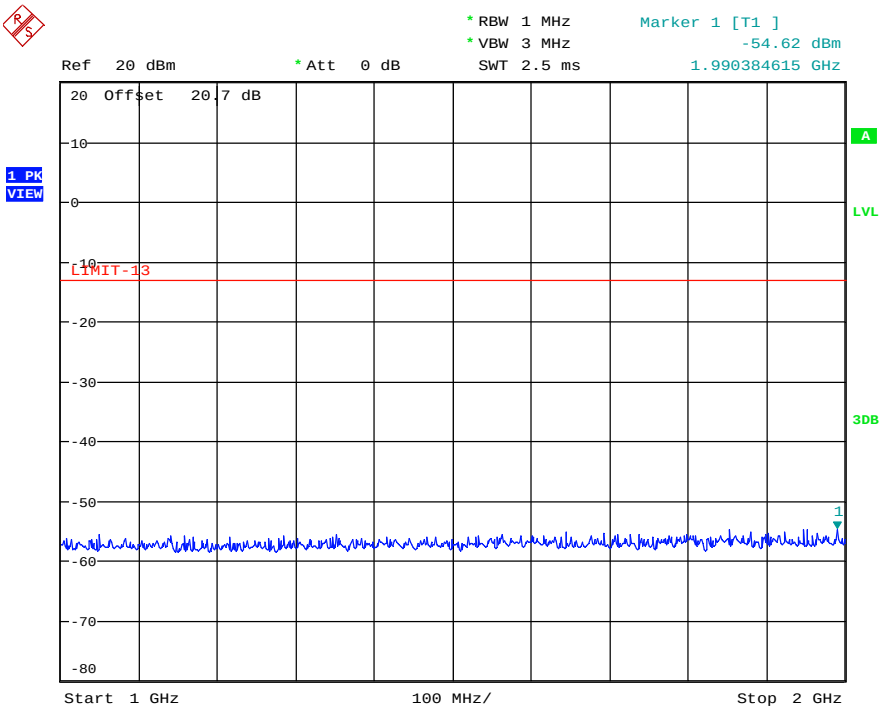


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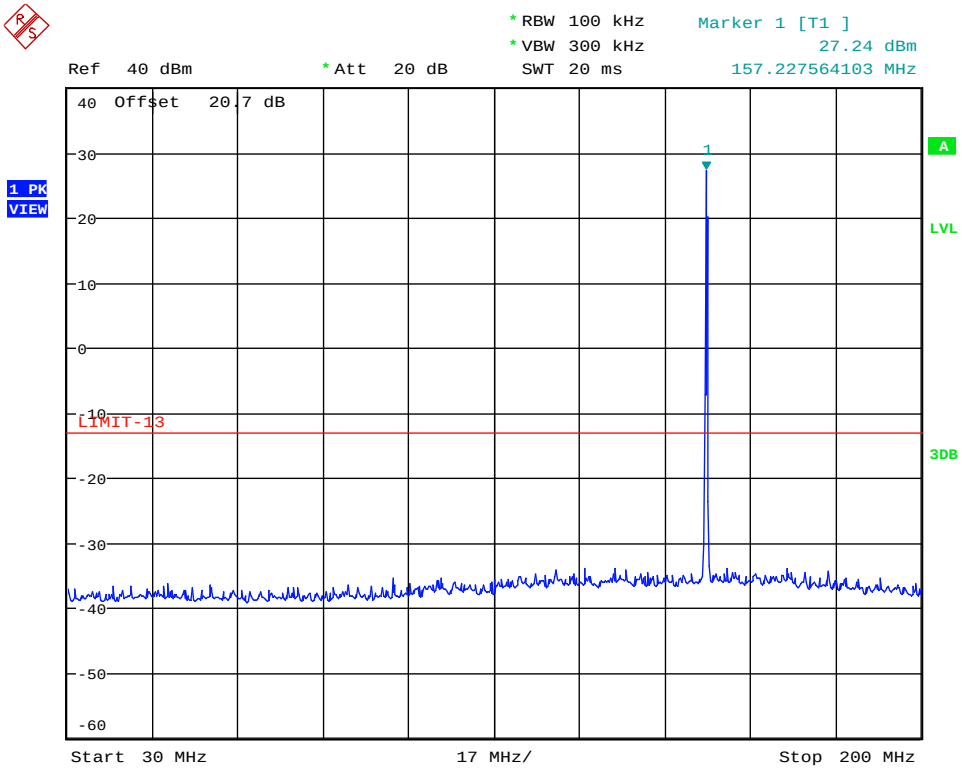
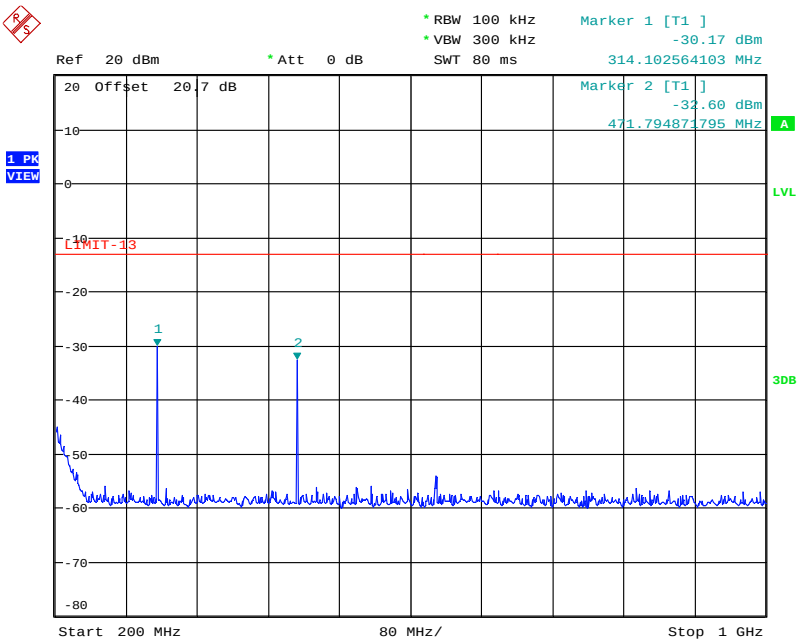
### 5.5.5.2. Configuration: 157.2 MHz, CW, Signal Input-0.2dB below AGC



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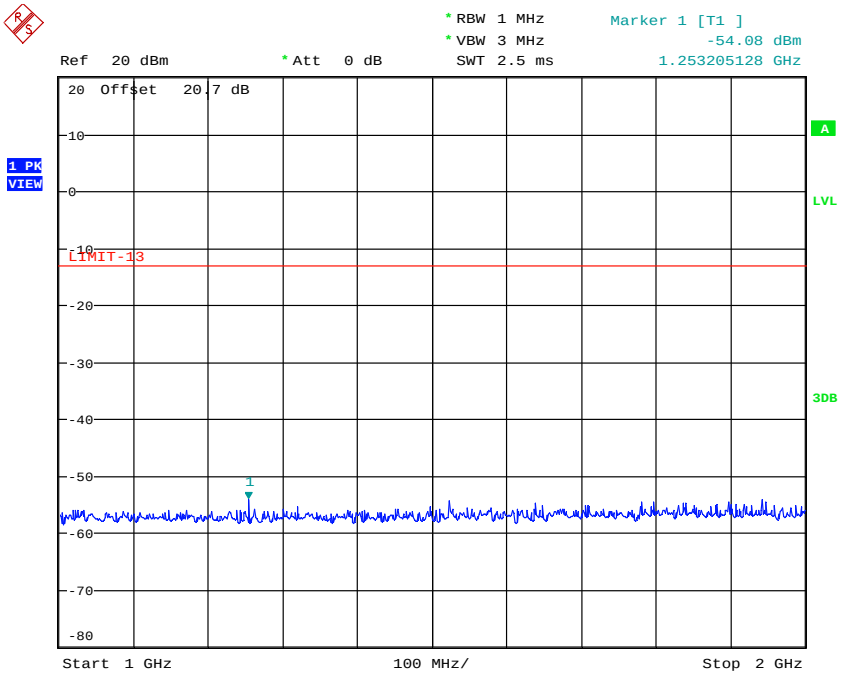


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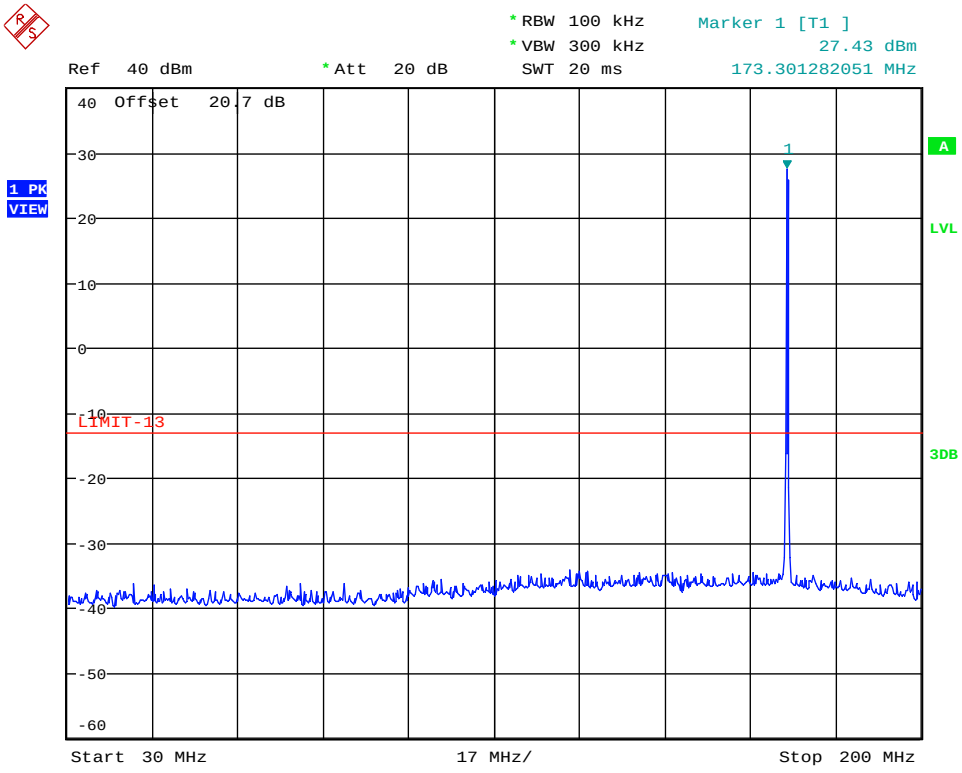
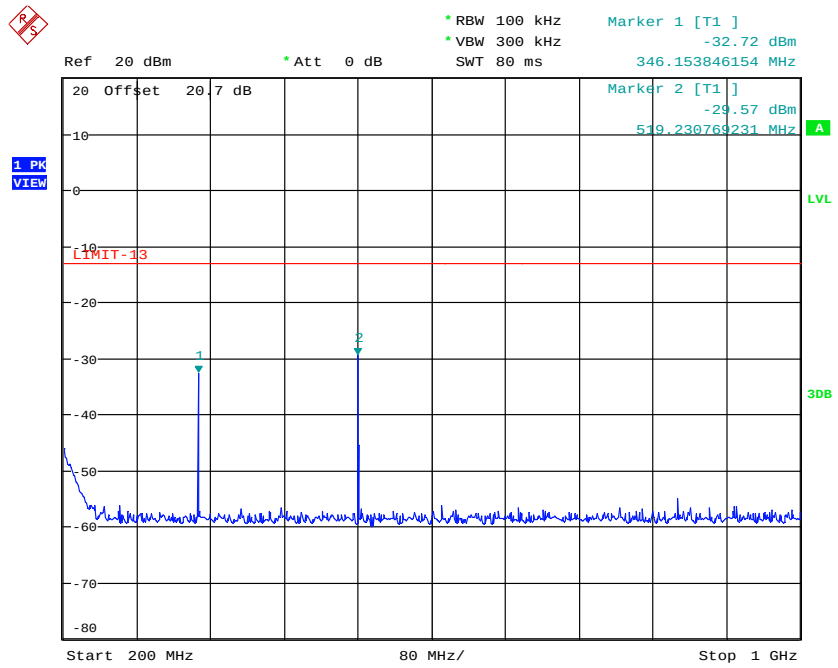
### 5.5.5.3. Configuration: 173.3 MHz, CW, Signal Input-0.2dB below AGC



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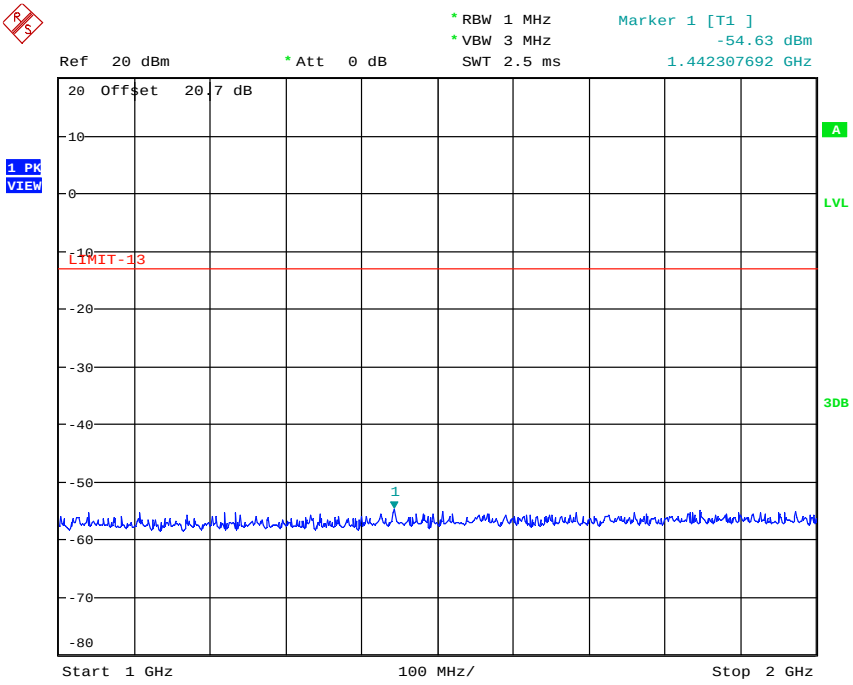


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## 5.6. Radiated Spurious Emissions

### 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.

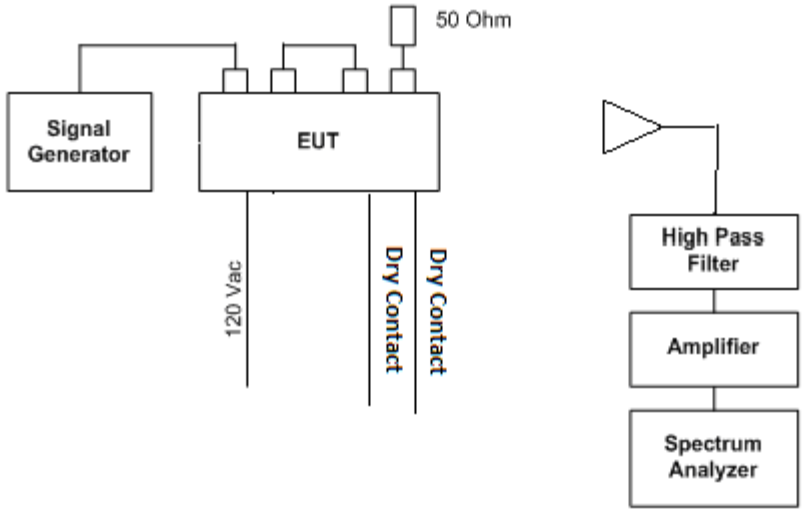
The RBW was set to 100 KHz for measurements below 1 GHz and 1 MHz for measurements above 1 GHz. The VBW was set to 3 times the RBW.

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: 150.1MHz**

| Frequency (MHz) | E-Field (dBuV/m) | EMI Detector (Peak/Qp/Avg) | Antenna Polarization(H/V) | ERP (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|
| 30-2000 | * | Peak | H/V | * | -13 | * |

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

**Test Frequency: 157.2 MHz**

| Frequency (MHz) | E-Field (dBuV/m) | EMI Detector (Peak/Qp/Avg) | Antenna Polarization(H/V) | ERP (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|
| 30-2000 | * | Peak | H/V | * | -13 | * |

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

**Test Frequency: 173.3 MHz**

| Frequency (MHz) | E-Field (dBuV/m) | EMI Detector (Peak/Qp/Avg) | Antenna Polarization(H/V) | ERP (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|
| 30-2000 | * | 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

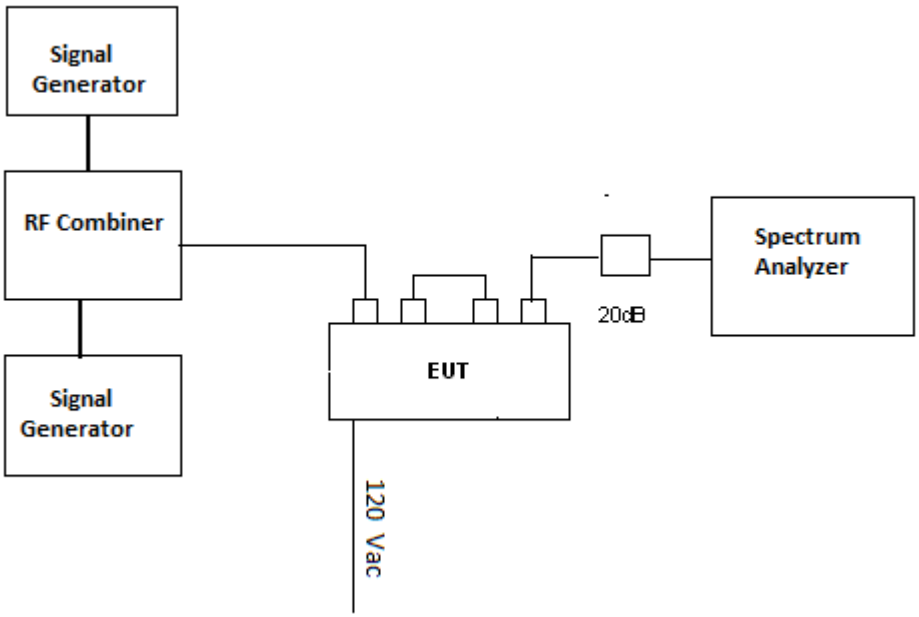
The EUT was connected to spectrum analyzer through a 20 dB attenuator. Two signal generators were utilized to produce a two tone signal with the 6.25, 12.5 and 25 KHz channel spacing set so the intermodulation products fell within the operational band.

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 | 138.1 | -21.82 | -21.43 | -13 | YES |
| | 148.1 | -21.82 | -22.63 | -13 | YES |
| | 150.1 | -22.13 | -24.61 | -13 | YES |
| | 157.2 | -21.63 | -24.26 | -13 | YES |
| | 173.3 | -22.98 | -29.38 | -13 | YES |
| 12.5 kHz | 138.1 | -22.18 | -21.73 | -13 | YES |
| | 148.1 | -21.37 | -23.76 | -13 | YES |
| | 150.1 | -21.22 | -21.40 | -13 | YES |
| | 157.2 | **-21.08** | -25.22 | -13 | YES |
| | 173.3 | -22.12 | -31.52 | -13 | YES |
| 25 kHz | 138.1 | -23.57 | -21.97 | -13 | YES |
| | 148.1 | -22.43 | -22.78 | -13 | YES |
| | 150.1 | -21.60 | -22.99 | -13 | YES |
| | 157.2 | -21.50 | -25.83 | -13 | YES |
| | 173.3 | -22.73 | -34.09 | -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 D05, ANSI C63.26, 90.219

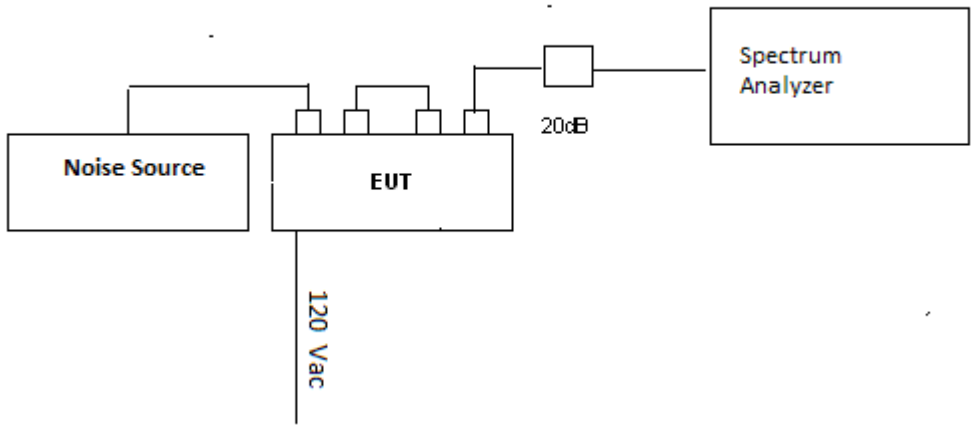
### 5.8.3. Test Procedure

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) | | |
| *138.1 | -75.78 | -75.81 | -42.40 | -31.49 | 2.50 | 9 |
| *148.1 | -75.83 | -75.72 | -42.37 | -31.39 | 2.42 | 9 |
| 150.1 | -75.86 | -75.93 | -42.12 | -31.19 | 2.47 | 9 |
| 157.2 | -75.98 | -75.90 | -41.95 | -30.80 | 2.24 | 9 |
| 173.3 | -75.98 | -75.85 | -42.31 | -31.00 | 2.06 | 9 |

*** Note- This test results are "Not applicable for FCC Certification" purpose.**

# 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:

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

**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) |
|---|---|---|---|---|---|---|---|
| 150.05 | 30 | 2.15 | 32.15 | 1640.6 | 38 | 0.1 | 0.2 |

# EXHIBIT 7. TEST EQUIPMENT LIST

| Test Instrument | Manufacturer | Model No | Serial No | Frequency Range | Cal Due date |
|---|---|---|---|---|---|
| Power Meter | Hewlett Packard | 436A | 2016A7747 | 10K--50G sensor dependent | 21 Mar 2019 |
| Power Sensor | Hewlett Packard | 8482A | MY41172054 | 10 MHz-4.2GHZ | 28 Oct 2019 |
| Signal Generator | Marconi Instruments | 2024 | 112255/164 | 9 KHz-2.4GHz | 16 Aug 2018 |
| Attenuator | Weinschel | 46-20-34 | BS5681 | DC–18 GHz | 14 Oct 2018 |
| Spectrum Analyzer | Rohde & Schwarz | FSEK30 | 100077 | 20Hz–40 GHz | Dec 5, 2018 |
| Spectrum Analyzer | Rohde & Schwarz | FSU26 | 200946 | 20Hz–26.5 GHz | Jul 21, 2018 |
| Signal Generator | Agilent | E8241A | US42110625 | 250 kHz-20 GHz | Sep 15, 2018 |
| Attenuator | Weinschel | 46-20-34 | BM1347 | DC–18 GHz | Mar 14, 2019 |
| Adjustable Attenuator | Hewlett Packard | 8495B | --- | DC–18 GHz | Cal on use |
| Power Meter | Hewlett Packard | 436A | 2101A11242 | 10K--50G sensor dependent | May 18, 2018 |
| Power Sensor | Hewlett Packard | 8481A | 2349A40815 | 10 MHz-4.2GHZ | Jul 24, 2018 |
| Vector Signal Generator | Rohde&Schwarz | SMJ 100A | 110791 | 100KHz-6GHz | Mar 15, 2019 |
| Noise source | Hewlett Packard | 346C | - | 10 MHz – 26.5 GHz | Cal on use |
| Signal Generator | IFR | 2025 | 202304/137 | 9 KHz-2.5GHz | Feb 7, 2019 |
| RF Combiner | Mini-Circuit | ZFRSC-123-S+ | SF139801142 | DC-12 GHz | Cal on Use |
| EMI Receiver | Rohde & Schwarz | ESU40 | 100037 | 20Hz–40 GHz | May 9, 2018 |
| EMI Receiver | Rohde & Schwarz | FSU26 | 200946 | 20Hz–26.5 GHz | Jul 21, 2018 |
| RF Amplifier | Com-Power | PA-103 | 161040 | 1-1000 MHz | Jun 5 2018 |
| RF Amplifier | Hewlett Packard | 84498 | 3008A00769 | 1 – 26.5 GHz | Oct 4, 2018 |
| Log Periodic Antenna | ETS-Lindgren | 3148 | 00023845 | 200-2000MHz | Jul 20, 2018 |
| Biconilog | Emco | 3142 | 9601-1005 | 26-2000 MHz | May 12, 2018 |
| Horn Antenna | Emco | 3155 | 6570 | 1 – 18 GHz | Oct 13, 2018 |
| High Pass Filter | Mini-Circuits | SHP-300 | 10427 | Cut off 200 MHz | Cal on use |

Note: All testing for this model was completed on May 9, 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 |