Compliance Testing, LLC
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Test Report

Prepared for: Bird Technologies

Model: 613-8

Description: SBIII Series Signal Booster

FCC ID: EZZ6138X

To

FCC Part 90

Date of Issue: November 29, 2017

On the behalf of the applicant:	**Bird Technologies** **30303 Aurora Road** **Solon, OH 44139**
Attention of:	**Amy Sanvido, RF Engineer** **Ph: (440)519-2179** **E-Mail: asanvido@bird-technologies.com**

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Greg Corbin

Greg Corbin
Project Test Engineer

Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	August 4, 2017	Greg Corbin	Original Document
2.0	November 27, 2017	Greg Corbin	Corrected max power statement on page 10 to match statement in manual. Added Note to page 13 regarding RBW.
3.0	November 29, 2017	Greg Corbin	Added additional analysis to the note on page 13 regarding RBW

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ILAC / A2LA

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The tests results contained within this test report all fall within our scope of accreditation, unless noted below.

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

Testing Certificate Number: **2152.01**

FCC Site Reg. #349717

IC Site Reg. #2044A-2

Non-accredited tests contained in this report:

N/A

The Applicant has been cautioned as to the following:

15.21: **Information to the 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 marketed 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.

Test and Measurement Data

All tests and measurement data shown were performed in accordance with FCC Rules and Regulations Part 90.219, KDB 935210 D05 Booster, and FCC Part 2, where appropriate.

Standard Test Conditions and Engineering Practices

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

In accordance with ANSI/TIA 603C, 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 specify testing over a different temperature range. Also, unless otherwise indicated, the humidity levels were in the range of 10% to 90% relative humidity.

Environmental Conditions		
Temp (ºC)	**Humidity (%)**	**Pressure (mbar)**
25.9 – 30.6	39.1 – 52.7	962.3 – 970.9

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

EUT Description
Model: 613-8
Description: SBIII Series Signal Booster

Additional Information:

The EUT is a Public Safety industrial signal booster.
The EUT operated at 120 VAC.

	Frequency (MHz)	**Emission Designators**
Downlink	764 – 775 (FCC) 768 – 776 (IC) 851 - 861	F1D, F1E, F3E, FXE, FXD, G1E, G1D, D7W,D7D, D1E, D1W, F9W
Uplink	794 – 805 (FCC) 798 – 806 (IC) 806 - 816	F1D, F1E, F3E, FXE, FXD, G1E, G1D, D7W,D7D, D1E, D1W, F9W

EUT Operation during Tests
The EUT was tested under normal operation.
Operational parameters are controlled via a web based browser.
A 30 dB, 50 watt attenuator was installed on both RF ports.

Accessories: None

Cables: None

Modifications: None

Test Result Summary

Specification	Test Name	Pass, Fail, N/A	Comments
KDB 935210 D05	AGC Threshold	Pass	
KDB 935210-D03	Out of Band Rejection	Pass	
2.1046	Output Power (Conducted)	Pass	
90.210 2.1049	Occupied Bandwidth (Emission Masks)	Pass	
2.1051 90.543(c)(e)(f)	Spurious Emissions (Transmitter Conducted)	Pass	
2.1053	Radiated Spurious Emissions	Pass	
KDB 935210-D03	Intermodulation	Pass	
90.219(e)(2)	Noise Figure	Pass	
90.213	Frequency Stability (Temperature Variation)	N/A	EUT does not perform frequency translation
90.213	Frequency Stability (Voltage Variation)	N/A	EUT does not perform frequency translation

AGC Threshold

Engineer: Greg Corbin

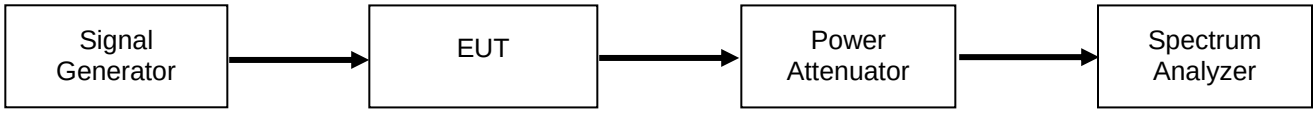
Test Date: 7/28/2017

Test Procedure

A signal generator producing a CW signal was connected to the input of the EUT. A spectrum analyzer was connected to the EUT in order to monitor the output power levels. The input power level was increase in 1 dB increments until the power no longer increased. The input levels were recorded in the table below.

Spectrum Analyzer settings
Power Channel integration
RBW = 1-5% of EBW
Video BW = 3x RBW

Test Setup



Mobile to Base

Frequency Band (MHz)	Tuned Frequency (MHz)	AGC Threshold (dBm)
794 – 805 (FCC) 798 – 806 (IC)	799.5	-59.2
806 - 816	811	-64.4

Base to Mobile

Frequency Band (MHz)	Tuned Frequency (MHz)	AGC Threshold (dBm)
764 – 775 (FCC) 768 – 776 (IC)	769.5	-59.8
851 - 861	856.0	-59.3

Out of Band Rejection

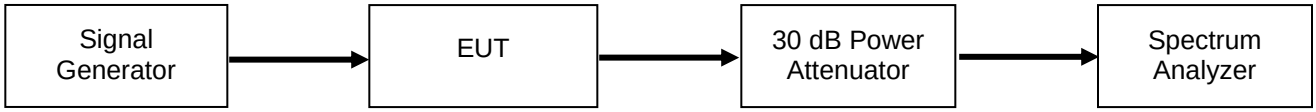
Engineer: Greg Corbin

Test Date: 7/24/17

Test Procedure

The EUT was connected to a spectrum analyzer through a 30 dB 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 Uplink and Downlink filter response and the -20 dB bandwidth were measured. The marker table function of the spectrum analyzer was used to show the peak amplitude in the passband and the -20 dB bandwidth of the pass band filter.
RBW = 100 KHz
Video BW = 3x RBW

Test Setup



Refer to Annex A for Authorized Frequency Band plots.

Conducted Output Power and Amplifier Gain

Engineer: Greg Corbin

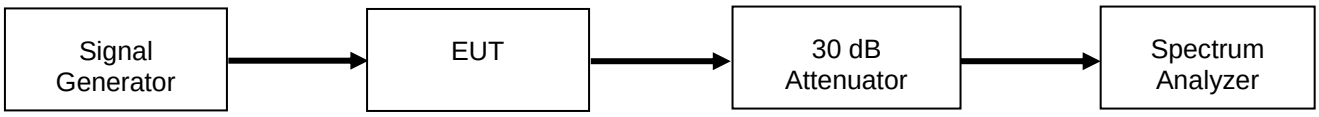
Test Date: 7/24/2017

Test Procedure

The Equipment Under Test (EUT) was connected to a spectrum analyzer through a 30 dB Power attenuator. All cable and attenuator losses were input into the spectrum analyzer as a reference level offset to ensure accurate readings were obtained.
A CW signal was utilized, set to the frequency of the peak amplitude measured in the Out of Band Rejection test.
The RF input signal level was set to 0.2 dB below the AGC Threshold.
RBW = 100 kHz
Video BW = 3x RBW
The Input and Output power levels were recorded and the gain was calculated using the following formula:

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

Test Setup



Output Power and Gain Test Results

Frequency Band (MHz)	Tuned Frequency (MHz)	Input Power (dBm)	Output Power (dBm)	Gain (dB)
764 – 775 (FCC) 768 – 776 (IC)	774.205	-63.2	34.9	98.1
794 – 805 (FCC) 798 – 806 (IC)	804.25	-62.6	33.7	96.3
806 - 816	810.25	-64.3	34.1	98.4
851 - 861	860.9	-59.2	32.9	92.1

Radiated Output Power
Radiated Power (ERP) is dependent on the cable loss and antennas used when installed. The manual contains the following statement
Caution: The ERP (effective radiated power) from the booster system must not exceed +37 dBm (5 Watts) in order to remain compliant with FCC regulations.

Conducted Spurious Emissions

Engineer: Greg Corbin

Test Date: 7/24/2017

Test Procedure

The Equipment Under Test (EUT) was connected to a spectrum analyzer through a 30 dB Power attenuator. All cable and attenuator losses were input into the spectrum analyzer as a combination of reference level offset and correction factor as needed to ensure accurate readings were obtained.
A CW signal was utilized, set to the center frequency of the passband.
The RF input signal level was set to 0.2 dB below the AGC Threshold.
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.

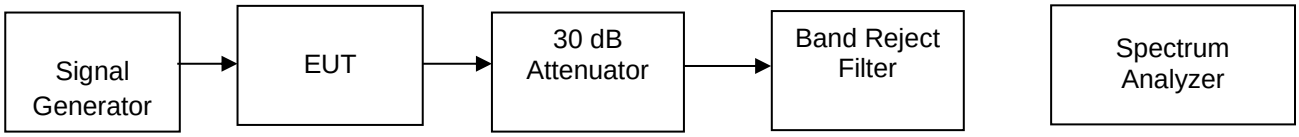
The frequency range from 30 MHz to the 10th harmonic of the passband frequency was observed and plotted.

Conducted spurious test data was also recorded for FCC part 90.543 (c)(e)(f) requirements.

The following formula was used for calculating the limits.

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

Test Setup



Refer to Annex B for Conducted Spurious Emissions Plots

Radiated Spurious Emissions

Engineer: Greg Corbin

Test Date: 7/26/17

Test Procedure

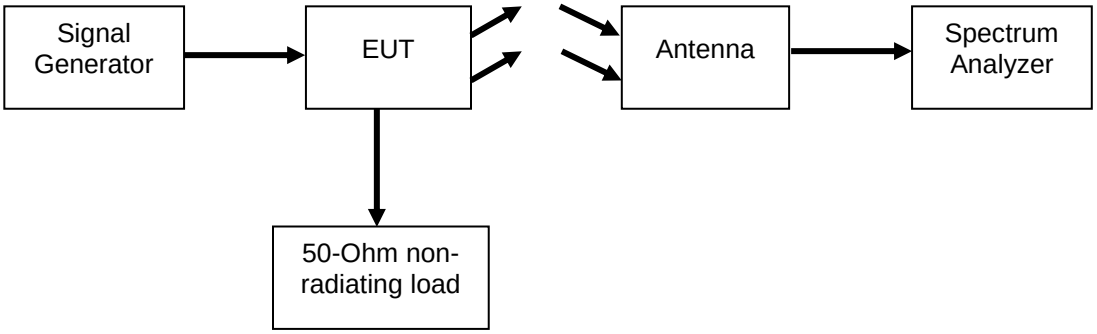
The EUT was tested in a semi-anechoic chamber with the turntable set 3m from the receiving antenna. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Emissions. The EUT was tested by rotating it 360 degrees with the antenna in both the vertical and horizontal orientation while raised from 1 to 4 meters to ensure that the signal levels were maximized. All cable and antenna correction factors were input into the spectrum analyzer ensuring an accurate measurement in ERP/EIRP with the resultant power in dBm. A signal generator was used to provide a CW signal. The EUT output was terminated into a 50 Ohm 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:

Radiated Spurious Emissions Limit = P1 – (43+ 10Log(P2)) = -13dBm
P1 = power in dBm
P2 = power in Watts

Test Setup



Test Results

No other emissions were detected. All emissions were noise floor measurements.

Refer to Annex C for the Radiated Spurious Emissions Plots

Emission Masks (Occupied Bandwidth)
Engineer: Greg Corbin
Test Date: 8/3/2017

Test Procedure

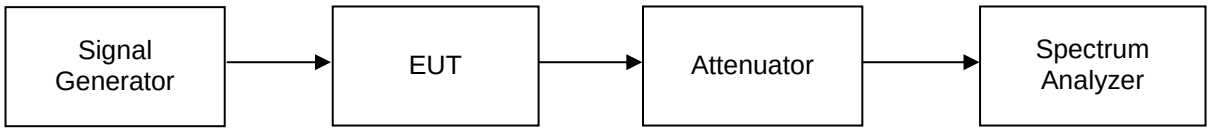
The EUT was connected directly to a spectrum analyzer to verify that the EUT meets the required emissions mask.
A reference level plot is provided to verify that the peak power was established prior to testing the mask.
The EUT is a booster amplifier that does not contain a transmitter; representative emission designators used in the industry were used for the emission masks and are listed in Table 1.
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.

Emission masks were recorded for C4FM and FCC rule section 90.691 as required.

***Note**:*
The RBW for some masks was set to 100 Hz vs 300 Hz as required. The equipment was not available to repeat those tests with a 300 Hz RBW after this error was discovered.
However the data has been analyzed and if the RBW was set to 300 Hz, the emissions would still be within the required emission limit and remain compliant with the specification.
The amplitude of the FM modulated signals will not increase with a change in RBW therefor the emission masks for the FM modulated signals would still remain compliant.
The amplitude of a broadband signal such as C4FM will be affected by the change in RBW.
The formula for RBW correction factor is 10 log [(reference bandwidth) / (measurement bandwidth)].
This correction factor is added to broadband type signals when a different RBW than specified is used.
The RBW correction factor that would be added to the amplitude of the C4FM emission mask measurements is 4.77 dB (10LOG(300 Hz / 100 Hz=4.77 dB).
In reviewing the C4FM emission mask data the amplitude of the signal is at least 10 dB below the mask limit, therefor if 4.77 dB is added to the amplitude of the C4FM signal the emissions would still be below the mask limit and remain in compliance.

Emission Designator	Emission Mask	Type of Modulation	Occupied Bandwidth (kHz)	Channel Spacing (kHz)	Audio Frequency (kHz)	Deviation (kHz)	RBW (Hz)
16K0F3E	B, C	FM	16.0	25	1.0	5.0	300
8K10F1D	C	C4FM	N/A	N/A	N/A	N/A	300
11K3F3E	G,H 90.691	FM, C4FM	11.3	12.5	1.0	2.5	300

Test Setup



Refer to Annex D for Emission Mask plots

Intermodulation

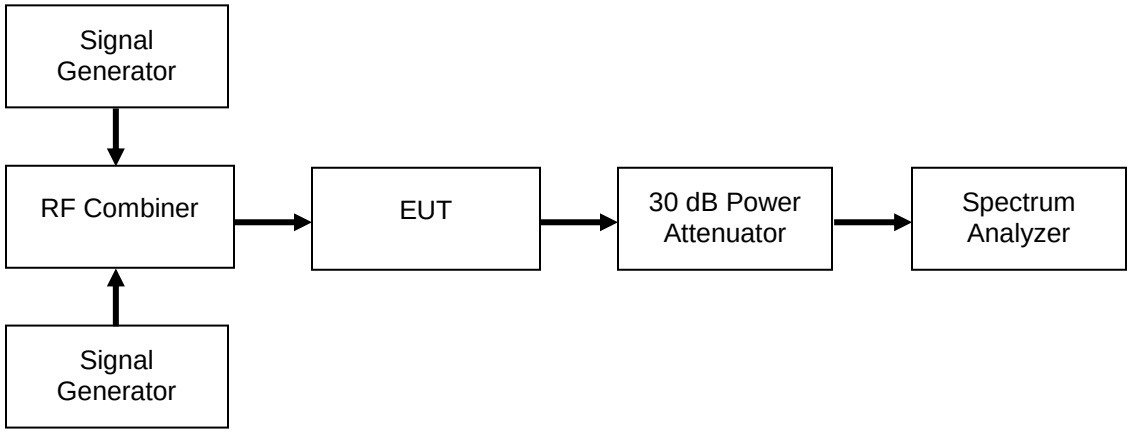
Engineer: Greg Corbin

Test Date: 7/27/2017

Test Procedure

The EUT was connected to a spectrum analyzer through a 30 dB power attenuator. Two signal generators were utilized to produce a two tone signal with the 12.5 KHz channel spacing set so the intermodulation products fell within the operational band. Frequency at the maximum power from out of band rejection was utilized.
The Test was performed on both the uplink and downlink.
The RF input signal level was set to 0.2 dB below the AGC Threshold.
RBW = 300 Hz
Video BW = 3x RBW

Test Setup



Refer to Annex E for Intermodulation plots

Noise Figure Test
Engineer: Greg Corbin
Test Date: 7/25/2017

Test Procedure

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

The noise figure was measured at the passband center frequency.
Noise figure was measured using the high power output.

Frequency Band (MHz)	Frequency (MHz)	Noise Figure (dB)	Limit (dB)	Margin (dB)
764 – 775 (FCC) 768 – 776 (IC)	769.5	3.9	9	5.1
794 – 805 (FCC) 798 – 806 (IC)	799.5	4.9	9	4.1
851 - 861	856	3.7	9	5.3
806 - 816	811	6.4	9	2.6

Test Equipment Utilized

Description	Manufacturer	Model Number	CT Asset #	Last Cal Date	Cal Due Date
Horn Antenna	ARA	DRG-118/A	i00271	6/16/16	6/16/18
Humidity / Temp Meter	Newport	IBTHX-W-5	i00282	6/9/17	6/9/18
Spectrum Analyzer	Agilent	E4407B	i00331	10/19/16	10/19/17
Bi-Log Antenna	Schaffner	CBL 6111D	i00349	8/3/16	8/3/18
Signal Generator	Rohde & Schwarz	SMU200A	i00405	5/5/17	5/5/18
Vector Signal Generator	Agilent	E4438C	i00348	2/16/16	2/16/18
Spectrum Analyzer	Textronix	RSA5126A	i00424	5/3/17	5/3/18
3 Meter Semi-Anechoic Chamber	Panashield	3 Meter Semi-Anechoic Chamber	i00428	8/15/16	8/15/19
Noise Figure Meter	HP	8970B	i00444	8/13/15	8/13/17
Noise Source	HP	346A	i00445	8/13/15	8/13/17
Voltmeter	Fluke	179	i00488	3/1/17	3/1/18

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.

END OF TEST REPORT