Test Report

Prepared for: Bird Technologies

Model: DDH1900

Description: 43dBm High Power Remote

Serial Number: N/A

FCC ID: V5FDDH1900P
IC: 11014A-DDH1900P

To

FCC Part 20
FCC Part 24 27
and
IC RSS-131

Date of Issue: May 24, 2018

On the behalf of the applicant: **Bird Technologies**
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Alex Macon
Project Test Engineer

Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	April 30, 2018	Alex Macon	Original Document
2.0	May 24, 2018	Alex Macon	Removed reference to uplink on page 10 Added descriptive statement on page 11 Corrected table on page 12

Table of Contents

ILAC / A2LA

Compliance Testing, LLC, has been accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer joint ISO-ILAC-IAF Communiqué dated January 2009)

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

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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, KDB 935210 D05 Indus Booster Basic Measurements v01 and FCC Part 2, Part 20.21, Part 24, Part 27 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)**
25.3	28.6	969

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

EUT Description
Model: DDH-1900
Description: Industrial Signal Booster
Serial Number: N/A
Additional Information: The EUT (equipment under test) is a remote unit connected to a DAS (Distributed Amplifier System) base station via fiber optic cables.
The downlink signal was input to the FOI (Fiber optic interface).
The gains were preset by the manufacturer.
The EUT operated at 120 VAC.
The EUT frequency band of operation was 1930 – 1995 MHz (downlink) and 1850 - 1915MHz (uplink).

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 the downlink output.
The EUT was setup in an end to end configuration.
Signals were injected into the head end unit and measured from the remote unit.

<u>Note: the UL is directly connected to a base station and therefore does not radiate.</u>

The signal booster uses the following frequency bands.
The emission designators listed are representative emission designators used by transmitters whose signal is amplified by this booster.

Frequency Band (MHz)	
Uplink	1850 - 1915
Downlink	1930 - 1995
Modulation Type	GSM, CDMA, EDGE, HSPA. EVDO, LTE

Emission Designators					
CDMA	**HSPA**	**LTE**	**EVDO**	**EDGE**	**GSM**
F9W	F9W	G7D	F9W	G7W	GXW

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 D05	Out-of-Band Rejection	Pass	
KDB 935210 D05	Input-Versus-Output Signal Comparison	Pass	
2.1046 KDB 935210 D05	Mean Output Power and Amplifier gain	Pass	
KDB 935210 D05	Out-Of-Band/Block Emissions Conducted	Pass	
2.1051 KDB 935210 D05	Spurious Emissions Conducted	Pass	
KDB 935210 D05	Frequency Stability	N/A	Does not have Frequency translation
2.1053 KDB 935210 D05	Spurious Emissions Radiated	Pass	

AGC Threshold
Engineer: Alex Macon
Test Date: 4/24/18

Test Procedure

A signal generator 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 Signal Generator was configured to produce the necessary broadband and narrow band signals. 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

Downlink

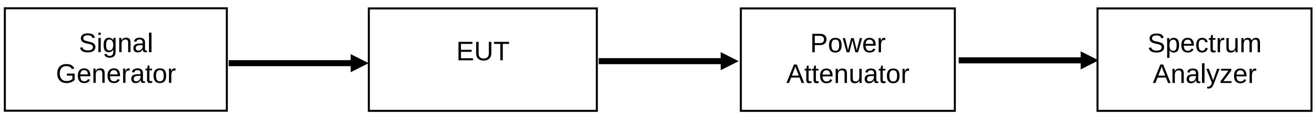
Tuned Frequency (MHz)	AGC Threshold (dBm)	
	AWGN	GSM
1962.5	-22.18.4	-22.6

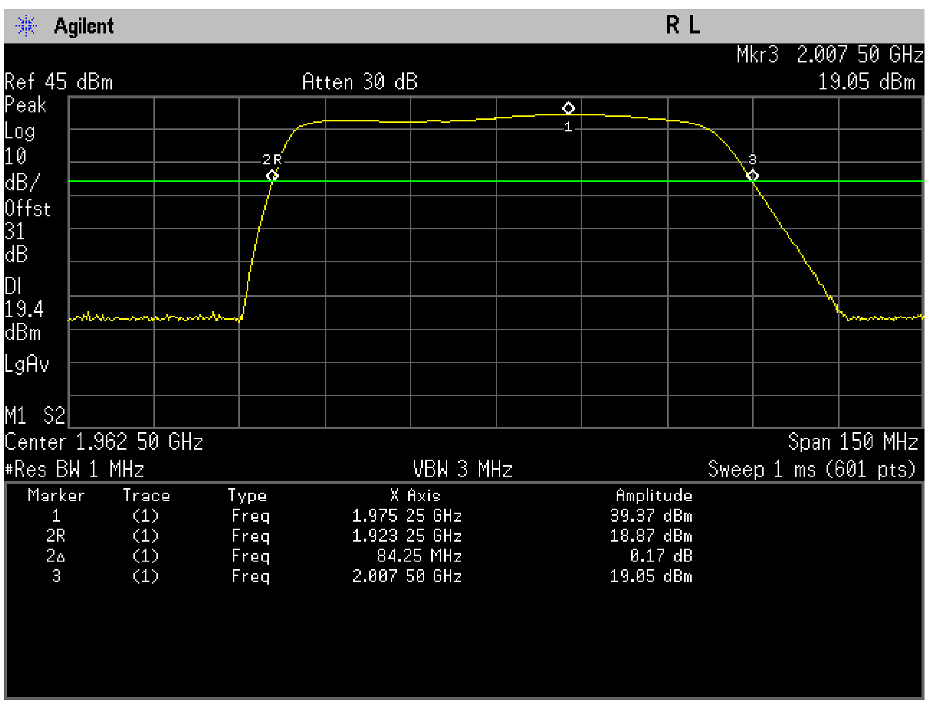
Out-Of-Band Rejection
Engineer: Alex Macon
Test Date: 4/24/18

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 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.

Test Setup





Input-Versus-Output Signal Comparison
Engineer: Alex Macon
Test Date: 4/24/18

Test Procedure

A signal generator was connected to the input of the EUT and was configured to transmit an AWGN signal.
The amplitude was set to be just below the AGC threshold level but not more than 0.5 dB.

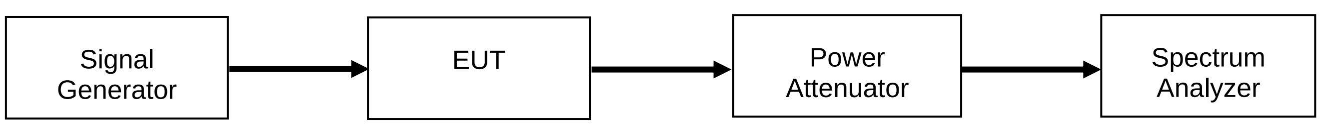
Spectrum analyzer setting:

Span 2 times to 5 times the EBW or alternatively the OBW.
Frequency set to the center frequency of the operational band under test.
RBW to 1% to 5 % of the anticipated OBW
VBW ≥ 3 × RBW
Reference Level 10 log (OBW / RBW) below the reference level
Positive Peak Detector
Max Hold

The -26dB bandwidth was compared between the input and the output of the EUT. All passbands applicable to the EUT were investigated. The input level was then increased by 3 dB above and the comparison repeated.

This test was repeated for the GSM narrowband signal.
The measured passband and rolloff characteristics features and relative spectral locations are similar throughout the comparison plots.

Test Setup



Refer to Annex A for Input vs Output plots.

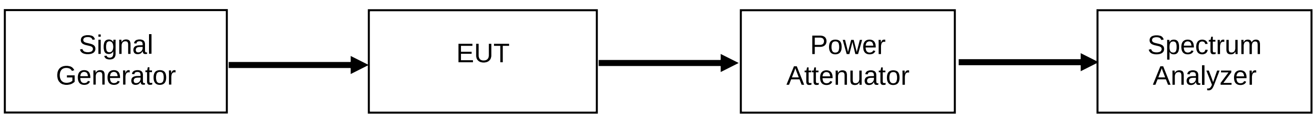
Mean Output and Amplifier Gain
Engineer: Alex Macon
Test Date: 4/24/18

Test Procedure

A signal generator tuned to the peak signal from the Out of Band Rejection data 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 Signal Generator was configured to produce the necessary broadband and narrow band signals.
The input power level was increase in 1 dB increments until the power no longer increased.
The input and output levels were recorded in the table below.
The amplifier gain was determined from the delta between the input and output levels.
The input level was increased 3 dB and the output power was recorded.

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

Test Setup



Downlink Output Power and Gain

GSM

Frequency Range (MHz)	Tuned Frequency (MHz)	Input Power (dBm)	Output Power (dBm)	Gain (dB)	(Input Power +3dB) Output Power (dBm)
1930 - 1995	1975.25	-23.2	43.14	66.34	43.5

AWGN

Frequency Range (MHz)	Tuned Frequency (MHz)	Input Power (dBm)	Output Power (dBm)	Gain (dB)	(Input Power +3dB) Output Power (dBm)
1930 - 1995	1975.25	-25.6	42.72	68.32	42.9

Out-Of-Band/Block Emission (Dual Carrier)
Engineer: Alex Macon
Test Date: 4/24/18

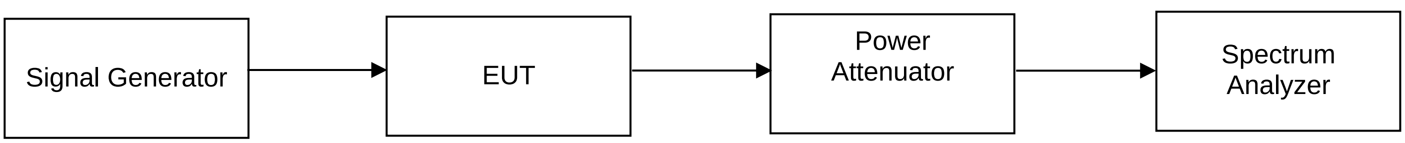
Test Procedure

A signal generator to the input of the EUT which was configured to produce two modulated AWGN carriers simultaneously. The center frequencies used were determined by the 3GPP standards and set to the lowest band edge and then to the highest band edge of each applicable band. The input power level was set to just below the AGC threshold but not more than 0.5dB.

The spectrum analyzer was set with the following parameters
RBW = 1 % of the emission bandwidth, 100 kHz, or 1 MHz
VBW = 3 × RBW
Average power detector
Sweep time = auto-couple
Trace average at least 100 traces in power averaging

Start frequency was set to the upper block edge frequency and the stop frequency to the upper block edge frequency plus 300 kHz or 3 MHz for frequencies below and above 1 GHz, respectively. The traces were captured and recorded. The input level was increased by 3dB and recorded again. This was repeated for all carriers being used with the EUT. The stop frequency was then set to the lower block edge and the start frequency set to 300 kHz or 3 MHz for frequencies below and above 1 GHz respectively. This was repeated for all carriers being used with the EUT. This was applied to all bands being used with the EUT.

Test Setup



Refer to Annex B for Out of Band/Block emission plots (dual Carrier)

Out-Of-Band/Block Emission (Single Carrier)

Engineer: Alex Macon

Test Date: 4/24/18

Test Procedure

A signal generator was connected to the input of the EUT which was configured to produce one modulated AWGN carrier. The center frequencies were set to the lowest available frequency within the band and then to the highest possible frequency in the band. The input power level was set to just below the AGC threshold but not more than 0.5dB.

The spectrum analyzer was set with the following parameters:

RBW = 1 % of the emission bandwidth, 100 kHz, or 1 MHz
VBW = 3 × RBW.
Detector to power averaging (rms)
Sweep time = auto-couple
Number of points ≥ (2 × span/RBW)
Trace average at least 10 traces in power averaging mode

The stop frequency was set to the lower band/block edge frequency. The start frequency was then set to 3MHz less than the stop frequency as specified in the applicable rule part.

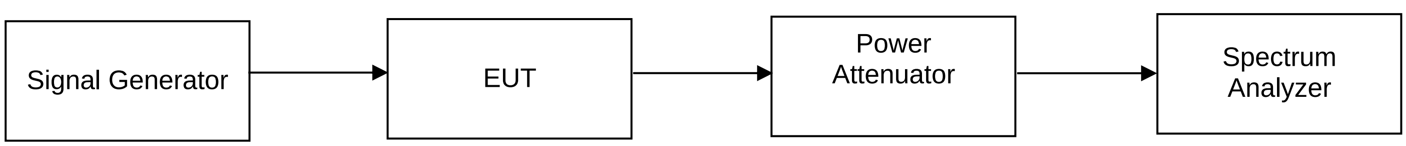
After the low side edges were recorder, the upper side edges were recorded in the following manner:

The start frequency was set to the upper band/block edge frequency. The stop frequency was then set to 3MHz greater than the stop frequency as specified in the applicable rule part.

All carriers and bands being used with the EUT were investigated.

The traces were captured and recorded.

Test Setup



Refer to Annex B for Out of Band/Block emission plots (single carrier)

Conducted Spurious Emissions
Engineer: Alex Macon
Test Date: 4/24/18

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.

The test is performed with a wideband AWGN signal and repeated with a narrowband GSM signal.

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.
An rms power averaging detector was used.
Trace averaging was utilized and the peak marker function was used.

The spectrum analyzer start frequency was set to the lowest RF signal generated in the equipment, without going below 9 kHz, and the stop frequency to the lower band/block edge frequency minus 100 kHz or 1 MHz, as specified in the applicable rule part.
A peak marker was placed at the highest amplitude and the trace was recorded.

The spectrum analyzer start frequency was set to the upper band/block edge frequency plus 100 kHz or 1 MHz, as specified in the applicable rule part, and the spectrum analyzer stop frequency to 10 times the highest frequency of the fundamental emission
A peak marker was placed at the highest amplitude and the trace was recorded.

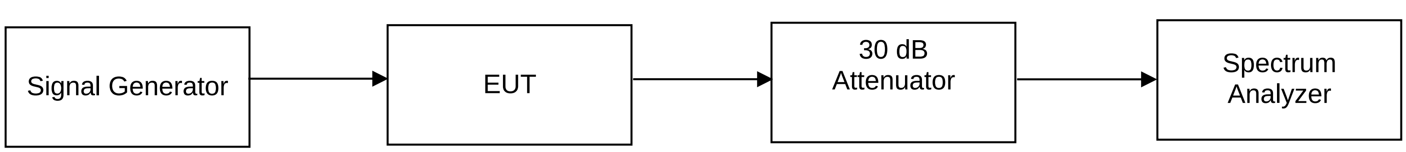
The frequency range from 9 kHz to the 10^{th} harmonic of the passband frequency was observed and plotted.

The test was repeated for the low, middle, high channels within the passband.

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 C for the Conducted Spurious Emissions Plots
*Note: Those emissions that appear over the limit but are located at the band/block edge show compliance in Annex B

Radiated Spurious Emissions
Engineer: Alex Macon
Test Date: 4/24/18

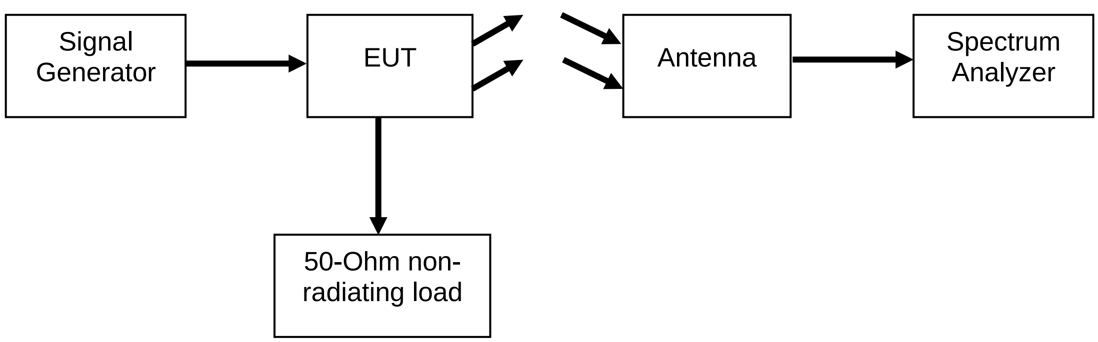
Test Procedure

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

Test Setup



Refer to Annex D for Radiated Spurious Emission plots

Test Equipment Utilized

Description	Manufacturer	Model #	CT Asset #	Last Cal Date	Cal Due Date
Horn Antenna, Amplified	ARA	DRG-118/A	i00271	6/16/16	6/16/18
Bi-Log Antenna	Schaffner	CBL 6111D	i00349	8/3/16	8/3/18
Humidity / Temp Meter	Newport	IBTHX-W-5	i00282	6/9/17	6/9/18
Signal Generator	Keysight (Agilent)	E4438C	I00457	10/19/16	10/19/18
PSA Spectrum Analyzer	Agilent	E4445A	i00471	9/6/17	9/6/18
Signal Generator	Agilent	E4437B	i00489	5/5/17	5/5/18

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