Test Report

Prepared for: G-Way Incorporated

Model: 900MHz Industrial Booster

Description: DL/896-901 MHz UL/935-940 MHz, DL 901-902 MHz UL/940-941 MHz

Serial Number: 16051002

FCC ID: Q8KPS93790R

To

FCC Part 20
FCC Part (90-S)
FCC Part 24D

Date of Issue: August 8, 2016

On the behalf of the applicant: G-Way Incorporated
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Greg Corbin

Greg Corbin
Project Test Engineer

Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	July 22, 2016	Greg Corbin	Original Document

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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.

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

Testing Certificate Number: **2152.01**

TESTING CERT
#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 24D, and Part 90-S 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)**
26.1 – 30.8	28.1 – 41.5	962.5 – 972.0

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

EUT Description
Model: 900MHz Industrial Booster
Description: DL/896-901 MHz UL/935-940 MHz, DL 901-902 MHz UL/940-941 MHz
Serial Number: 16051002
Additional Information:
The EUT is classified as a Part 90-S **Class B** industrial signal booster from 935 to 940 MHz uplink and 896 – 901 MHz downlink bands.
The EUT is classified as a Part 24-D **Class B** industrial signal booster from 940 - 941 MHz uplink and 901 - 902 MHz downlink bands.

The EUT is a Bi-directional Amplifier that operates in the Frequency ranges listed in Table 1.

System Power is 120 VAC @ 60 Hz.

The emission designators listed in Table 1 are representative emission designators used by transmitters whose signal is amplified by this booster.

Table 1

Frequency - MHz		Emission Designators
Base to Mobile	**Mobile to Base**	
935 – 940 940 - 941	896 – 901 901 - 902	F3E, G1D, G1E, W7W, F2D

EUT Operation during Tests

The EUT was tested under normal operating conditions with the front panel attenuators set to 0 dB for all measurements.

30 dB, 50 watt attenuators were installed on both RF ports for all tests.
For all the tests requiring a modulating signal,
AWGN and GSM were used for the 896 – 901 MHz, 935 – 940 MHz passbands.
16 QAM was used for the 901 – 902 MHz, 940 – 941 MHz passband.

Accessories: None

Cables:

Qty	Description	Length (M)	Shielding Y/N	Shielded Hood Y/N	Termination
1	AC Power Cable	2	N	N	N/A

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	
24.133(a)(1)	Emission Limits	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 24.133(a)(1) 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: Greg Corbin
Test Date: 7/8/2016

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

Base to Mobile

Tuned Frequency (MHz)	AGC Threshold (dBm)	
	AWGN	GSM
935.7	-48.7	--49.3

Mobile to Base

Tuned Frequency (MHz)	AGC Threshold (dBm)	
	AWGN	GSM
898.5	-48.9	-49.0

Base to Mobile

Tuned Frequency (MHz)	AGC Threshold (dBm)
	16 QAM
940.5	-50.5

Mobile to Base

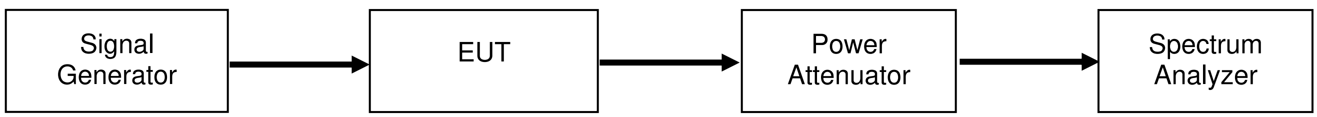
Tuned Frequency (MHz)	AGC Threshold (dBm)
	16 QAM
901.5	-50

Out-Of-Band Rejection
Engineer: Greg Corbin
Test Date: 7/8/2016

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 Out of Band Rejection Test Results

Input-Versus-Output Signal Comparison
Engineer: Greg Corbin
Test Date: 7/11/2016

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.

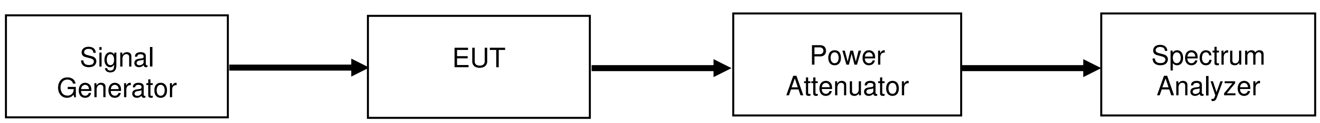
Spectrum analyzer setting:

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.

Test Setup



Refer to Annex B for Input vs Output Test Results

Emission Mask
Engineer: Greg Corbin
Test Date: 7/21/2016

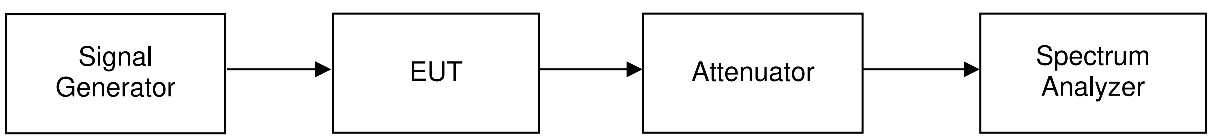
Test Procedure

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 940 - 941 MHz and 901 - 902 MHz bands were tested with a type of iDEN modulation.
16 QAM signals with 24.3 ksym/s were used to simulate the iDEN modulation.
The output signal was tested to the required mask.

Test Setup



Refer to Annex C for Emission Mask plots

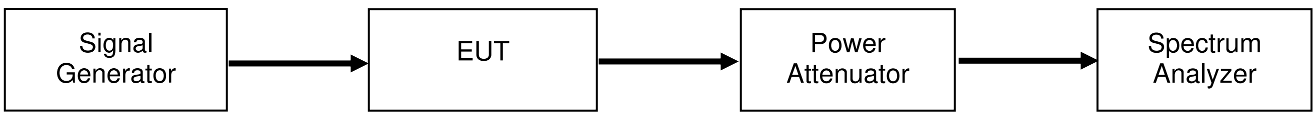
Mean Output and Amplifier Gain
Engineer: Greg Corbin
Test Date: 7/11/2016

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



Output Power and Gain Test Results

Base to Mobile

Frequency Range (MHz)	Tuned Frequency (MHz)	Modulation	Input Power (dBm)	Output Power (dBm)	Gain (dB)	(Input Power +3dB) Output Power (dBm)
935 - 940	937.4	AWGN	-48.4	36.5	84.9	36.7
935 - 940	937.4	GSM	-49.1	36.3	85.4	36.5
940 - 941	940	16 QAM	-50.7	34.5	85.2	34.8

Mobile to Base

Frequency Range (MHz)	Tuned Frequency (MHz)	Modulation	Input Power (dBm)	Output Power (dBm)	Gain (dB)	(Input Power +3dB) Output Power (dBm)
896 - 901	898	AWGN	-48.6	35.6	84.2	35.8
896 - 901	898	GSM	-49	35.3	84.3	35.5
901 - 902	901	16 QAM	-50.2	33.3	83.5	33.7

Out-Of-Band/Block Emission (Dual Carrier)
Engineer: Greg Corbin
Test Date: 7/11/2016

Test Procedure

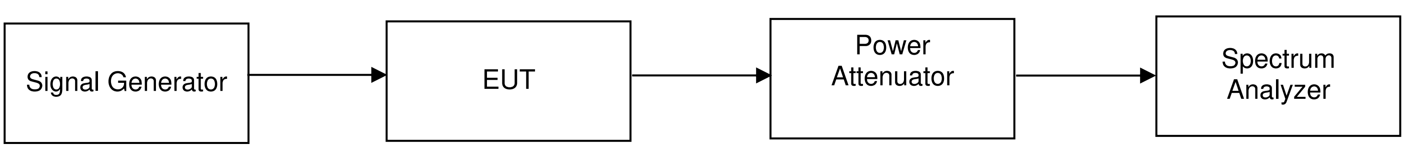
A signal generator to the input of the EUT which was configured to produce two modulated AWGN carriers simultaneously. The center frequencies used were determined by the 3GPP standards and set to the lowest band edge and then to the highest band edge of each applicable band. The input power level was 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 minus 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.

The test was repeated using AWGN and GSM modulation for the 896 – 901 MHz, 935 – 940 MHz passband.
The test was repeated using 16 QAM modulation for the 901 – 902 MHz and 940 – 941 MHz passband. ‘

Test Setup



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

Out-Of-Band/Block Emission (Single Carrier)
Engineer: Greg Corbin
Test Date: 7/11/2016

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 was 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:

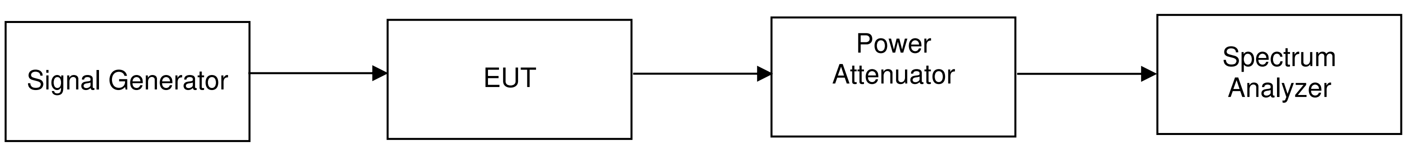
RBW = 1 % of the emission bandwidth, 100 kHz, or 1 MHz
VBW = 3 × RBW.
Detector to power averaging (rms)
Sweep time = auto-couple
Number of points ≥ (2 × span/RBW)
Trace average at least 10 traces in power averaging mode

The start frequency was set to the lowest radio frequency signal generated in the equipment, without going below 9 kHz, and the stop frequency to the lower band/block edge frequency minus 300 kHz or 3 MHz, as specified in the applicable rule part.

The start frequency was set to the upper band/block edge frequency plus 300 kHz or 3 MHz, as specified in the applicable rule part and the analyzer stop frequency to 10 times the highest frequency of the fundamental emission

The test was repeated using AWGN and GSM modulation for the 896 – 901 MHz, 935 – 940 MHz passband.
The test was repeated using 16 QAM modulation for the 901 – 902 MHz and 940 – 941 MHz passband. ‘

Test Setup



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

Conducted Spurious Emissions
Engineer: Greg Corbin
Test Date: 7/21/2016

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 for 896 – 901 MHz and 935 – 940 MHz.
This test was repeated with a 16 QAM signal for 901 -902 MHz and 940 – 941 MHz.

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.
A scan was performed using a peak detector and max hold.
Any signals close to the limit were analyzed with an RMS detector with trace averaging was used for the final measurement.

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.

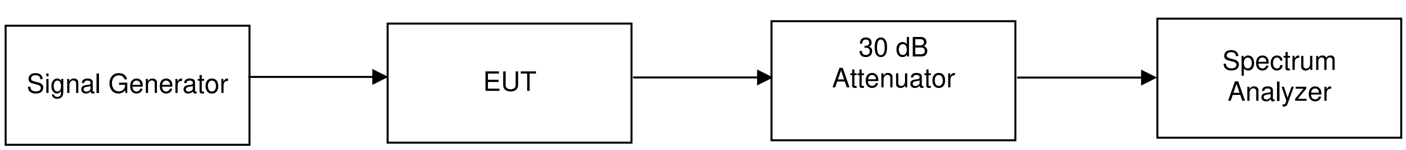
The frequency range from 9 kHz to the 10^{th} harmonic of the passband frequency was observed and plotted.

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 E for the Conducted Spurious Emissions Plots

Radiated Spurious Emissions
Engineer: Greg Corbin
Test Date: 7/29/2016

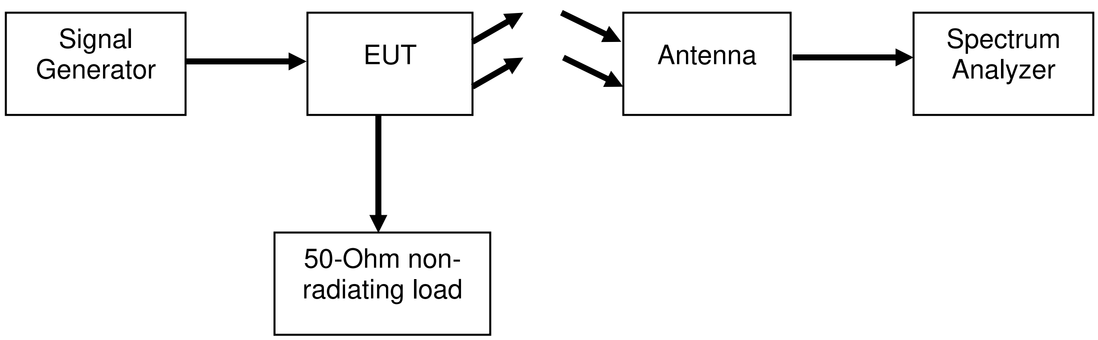
Test Procedure

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 F for Radiated Spurious Emission plots

Test Equipment Utilized

Description	Manufacturer	Model #	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	5/26/16	5/26/17
Bi-Log Antenna	Schaffner	CBL 6111D	i00349	10/19/15	10/19/17
EMI Analyzer	Agilent	E7405A	i00379	2/11/16	2/11/17
Signal Generator	Rohde & Schwarz	SMU200A	i00405	1/22/16	1/22/17
Spectrum Analyzer	Textronix	RSA5126A	i00424	3/28/16	3/28/17
3 Meter Semi-Anechoic Chamber	Panashield	3 Meter Semi-Anechoic Chamber	i00428	7/27/14	7/27/17
Preamplifier	Miteq	AFS44 00101 400 23-10P-44	i00509	N/A	N/A

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