

Test Report

Report No.: E202401190153-01-3

Customer: TowerIQ, Inc.

Address: 13723 Riverport Drive C/O Potter Electric Signal Company Saint Louis, MO 63043

Sample Name: Public safety signal booster

Sample Model: Guardian UHF 5W Class B

Receive Sample Date: Jan 22, 2024

Test Date: Feb 2, 2024~ Feb 22, 2024

Reference Document: FCC PART 90-- PRIVATE LAND MOBILE RADIO SERVICES

Test Result: PASS

FCC ID: 2AXVJGUARD-UHFB

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TABLE OF CONTENTS

1.	Applicant information.....	5
1.1.	Client information.....	5
1.2.	Manufacturer and Factory.....	5
2.	General description of EUT.....	5
2.1.	Basic description of EUT.....	5
2.2.	Test signal modulation description	6
2.2.1.	Analog signals	6
2.2.2.	Digital signals	6
2.3.	Signal Booster control process	7
2.3.1.	System block.....	7
2.3.2.	Signal control process.....	7
2.4.	Description of Booster connection port.....	8
3.	Related documents.....	9
4.	Test result summary.....	10
5.	About Signal Booster.....	11
5.1.	KDB 935210 D02 APPENDIX A3.1	11
5.2.	FCC part 90.219 (a) Definitions	11
6.	Test modes.....	12
7.	Laboratory	13
8.	Measurements uncertainty	13
9.	Instruments used during test	14
10.	Radio technical requirement specification.....	15
10.1.	Test Frequencies	15
10.1.1.	Requirements	15
10.1.2.	Result	17
10.2.	Input Signals	18
10.2.1.	Requirements	18
10.2.2.	Result	18
10.2.3.	Input Signals screenshot	19
10.3.	AGC Threshold.....	34
10.3.1.	Requirements	34
10.3.2.	Test configuration	34
10.3.3.	Test procedures	35
10.3.4.	Test results	36
10.4.	Out-of-band rejection.....	38
10.4.1.	Requirements	38
10.4.2.	Test configuration	38
10.4.3.	Test procedures	39
10.4.4.	Test results	40
10.4.5.	Test screenshot.....	41
10.5.	Input VS output Comparison	42
10.5.1.	Requirements	42

10.5.2.	Test configuration	47
10.5.3.	Test procedures	48
10.5.4.	Test results	49
10.5.5.	Test screenshot.....	64
10.6.	Mean power and amplifier/booster gain	144
10.6.1.	Requirements	144
10.6.2.	Test configuration	144
10.6.3.	Test procedures	145
10.6.4.	Test results	146
10.7.	Noise figure	152
10.7.1.	Requirements	152
10.7.2.	Test configuration	152
10.7.3.	Test procedures	154
10.7.4.	Test results	155
10.7.5.	Test screenshot.....	156
10.8.	Out-of-band/out-of-block emissions	159
10.8.1.	Requirements	159
10.8.2.	Test configuration	160
10.8.3.	Test procedures	161
10.8.4.	Test results	162
10.8.5.	Test screenshot.....	165
10.9.	Conducted spurious emissions.....	183
10.9.1.	Limit	183
10.9.2.	Test configuration	184
10.9.3.	Test procedures	185
10.9.4.	Test results	186
10.9.5.	Test screenshot.....	187
10.10.	Frequency stability.....	193
10.10.1.	Limit	193
10.10.2.	Test configuration	194
10.10.3.	Test procedures	195
10.10.4.	Test results.....	196
10.11.	Radiated spurious emissions	198
10.11.1.	Requirements	198
10.11.2.	Test configuration	200
10.11.3.	Test procedures	201
10.11.4.	Test results	203
11.	APPENDIX A. PHOTOGRAPH OF THE TEST CONNECTION DIAGRAM.....	207
12.	APPENDIX B. PHOTOGRAPHS OF EUT	210
12.1.	External photos	210

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1. Applicant information

1.1. Client information

Name: TowerIQ, Inc.

Address: 13723 Riverport Drive C/O Potter Electric Signal Company Saint Louis, MO 63043

1.2. Manufacturer and Factory

Name: TowerIQ, Inc. (Shenzhen Office)

Address: B511, Building B, Huashengtai Technology Building, No 36 Hangkong Road, Sanwei Community Hangcheng Street, Baoan District, Shenzhen

Factory: TowerIQ, Inc.

Address: 13723 Riverport Drive C/O Potter Electric Signal Company Saint Louis, MO 63043

2. General description of EUT

2.1. Basic description of EUT

Product Name: Public safety signal booster

Product Model: Guardian UHF 5W Class B

Trade Name: TowerIQ

Power Supply: Typical DC input power: DC +24V

Frequency Band: Downlink: 450MHz ~ 512MHz, Uplink: 450MHz ~ 512MHz

Nominal Output Power: Downlink: 36dBm $\pm$ 1dB (center frequency);
Uplink: 27dBm $\pm$ 1dB (center frequency)

Nominal Gain: Downlink: 90 $\pm$ 2dB (center frequency), Uplink: 90 $\pm$ 2dB (center frequency)

EUT Operating Temperature: -20°C to +50°C

Operating Humidity: 5% to 95%

Antenna Type: N/A

NOTE 1: The device is a Wideband device, which belongs to Class B signal booster.

NOTE 2: The device is an outdoor device, the device does not provide antenna by Manufacturer's statement, but it is required that the Antenna gain shall not exceed 0 dBi for Downlink and 9dBi for Uplink when the project is used by Manufacturer's statement.

NOTE 3: According to the product requirements, this device can adjust the downlink output power to 2.5W through software, but this verification will only perform a 5W test device.

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2.2. Test signal modulation description

According to FCC PART 2.202 (g), Table of necessary bandwidths follow:

2.2.1. Analog signals

Emission Designator	Description	Modulation type	M (modulation Freq, kHz)	R (Rate, baud)	D (Deviation, kHz)	K (numeric constant)	S (Symbols)	Bandwidth Calculation	Necessary Bandwidth
4K00F1E	Narrowband Analog FM Voice	FM	1.0	—	1	1.0	—	$B_n=2M+2DK$	4.0
11K0F3E	Narrowband Analog FM Voice	FM	3.0	—	2.5	1.0	—	$B_n=2M+2DK$	11.0
16K0F3E	Wideband Analog FM Voice	FM	3.0	—	5.0	1.0	—	$B_n=2M+2DK$	16.0

2.2.2. Digital signals

Emission Designator	Description	Modulation type	M (modulation Freq, kHz)	R (Rate, baud)	D (Deviation, kHz)	K (numeric constant)	S (Symbols)	Bandwidth Calculation	Necessary Bandwidth
8K10F1E	P25 Phase I C4FM Voice	4FSK	—	9600	1.8	0.916	4	$B_n=(R/\log_2 S)+2DK$	8.1
8K10F1D	P25 Phase I C4FM Data	4FSK	—	9600	1.8	0.916	4		8.1
8K10F1W	P25 Phase II H-CPM Voice/Data	4FSK	—	9600	1.8	0.916	4		8.1
9K80F1E	P25 Phase II H-DQPSK Voice	QPSK	—	12000	—	0.817	4	$B_n=2RK/\log_2 S$	9.8
9K80F1D	P25 Phase II H-DQPSK Data	QPSK	—	12000	—	0.817	4		9.8

NOTE: In the above test signal modes, the typical signal and the worst mode signal are used as representatives in this test. the specific test signal types are as follows:

Emission Designator	Description	Modulation type	M (modulation Freq, kHz)	R (Rate, baud)	D (Deviation, kHz)	K (numeric constant)	S (Symbols)	Bandwidth Calculation	Necessary Bandwidth
4K00F1E	Narrowband Analog FM Voice	FM	1.0	—	1	1.0	—	$B_n=2M+2DK$	4.0
11K0F3E	Narrowband Analog FM Voice	FM	3.0	—	2.5	1.0	—	$B_n=2M+2DK$	11.0
16K0F3E	Wideband Analog FM Voice	FM	3.0	—	5.0	1.0	—	$B_n=2M+2DK$	16.0
8K10F1D	P25 Phase I C4FM Data	4FSK	--	9600	1.8	0.916	4	$B_n=(R/\log_2 S)+2DK$	8.1
9K80F1D	P25 Phase II H-DQPSK Data	QPSK	--	12000	—	0.817	4	$B_n=2RK/\log_2 S$	9.8

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2.3. Signal Booster control process

2.3.1. System block

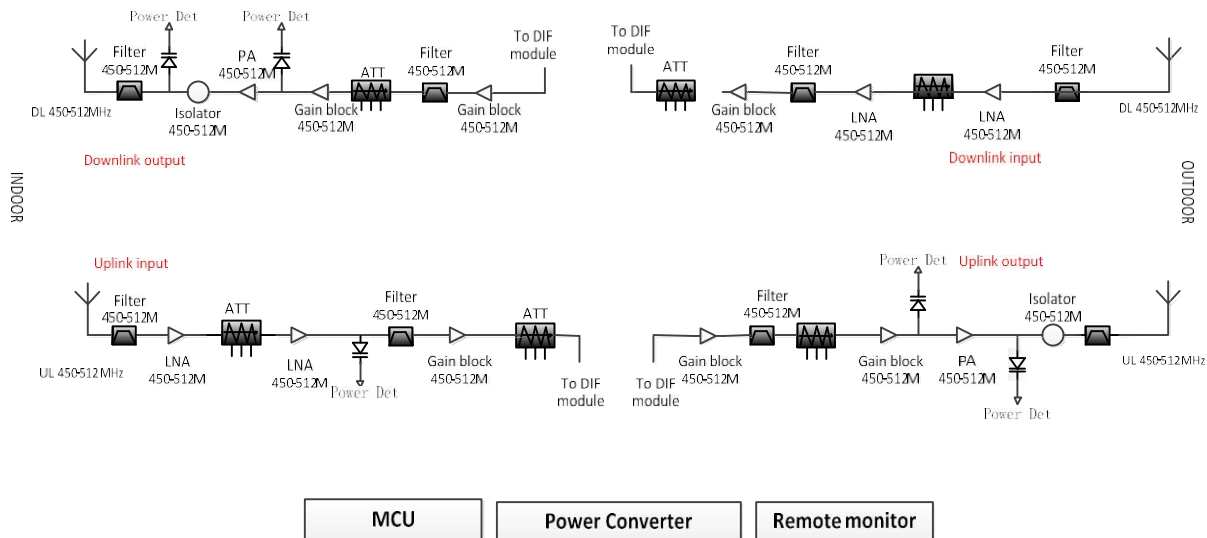


Figure 2.3-1 System block diagram

The block diagram is composed of the following units:

- Uplink input Power detector;
- Uplink output Power detector;
- Uplink PA switch integrated in PA;
- Downlink input Power detector;
- Downlink PA switch integrated in PA, and so on;

2.3.2. Signal control process

Above is the system block diagram, this system can enhance mobile communication signal. In the downlink, the BTS signals are received by donor antenna of the booster. After the duplexer, the signals are sent to the LNA module for pre-amplification and digital RF integrated module for digital filtering and frequency conversion.

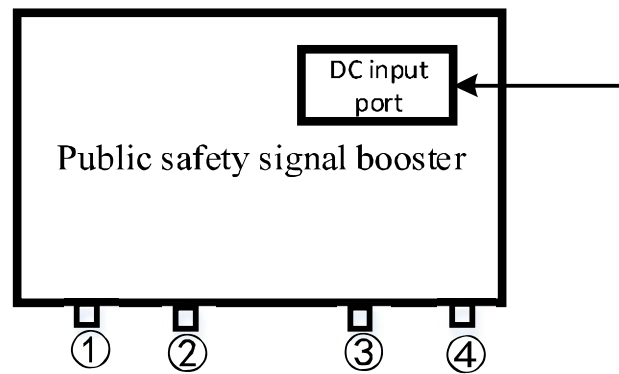
Then the DL signals will be sent to downlink PA to amplify power and filter via duplexer. After amplification, the signals are transmitted via the MT port to the service antenna.

In the uplink, the mobile signals are received by the service antenna. After the MT port integrated duplexer, the signals are sent to the LNA, integrated module for digital filtering, then to PA for power amplification and to duplexer.

After that, the uplink signals are sent to the donor antenna for transmission back to the BTS.

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2.4. Description of Booster connection port



NOTE: ① DOWNLINK OUTPUT
② UPLINK INPUT
③ UPLINK OUTPUT
④ DOWNLINK INPUT

———— The following blanks ————

3. Related documents

FCC PART 2 (2024)

FCC PART 90 (2024)

KDB 935210 D05 Indus Booster Basic Meas v01r04

KDB 935210 D02 Signal Boosters Certification v04r02

KDB 971168 D01 Power Meas License Digital Systems v03r01

ANSI/TIA 603-E-2016

ANSI/TIA-102.CAAA-E-2016

ANSI C63.26-2015

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4. Test result summary

Test Item	Test Requirements	Test Method	Reported	N/A
Test Frequency	KDB 935210 D02 APPENDIX D/Table D.3, FCC PART 2.1057, ANSI C63.26-2015 Clause 5.1.2	/	Reported only	
Input Signals	KDB 935210 D05 clause 4.1	/	Reported only	
AGC Threshold	KDB 935210 D05 clause 4.2	/	Reported only	
Out of Band Rejection	KDB 935210 D05 clause 4.3 FCC PART 90.219 (a) FCC PART 90.219 (d)((7))	KDB 935210 D05 clause 4.3	☒	
Input VS output Comparison	KDB 935210 D05 clause 4.4 FCC PART 2.1049(c) FCC PART 90.219 (e)(4)(ii)	KDB 935210 D05 clause 4.4	☒	
Mean power and amplifier/booster gain	KDB 935210 D05 clause 4.5 FCC PART 90.219 (e)(1)	KDB 935210 D05 clause 4.5	☒	
Noise Figure	KDB 935210 D05 clause 4.6 FCC PART 90.219 (e)(2)	KDB 935210 D05 clause 4.6	☒	
Out-of-band/out-of-block emissions	KDB 935210 D05 clause 4.7.2 FCC PART 2.1051 FCC PART 90.219 (d)(6)(i) FCC PART 90.219 (e)(3)	KDB 935210 D05 clause 4.7.2	☒	
Conducted spurious emissions	KDB 935210 D05 clause 4.7.3 FCC PART 2.1051 FCC PART 90.219 (e)(3)	KDB 935210 D05 clause 4.7.3	☒	
Frequency stability	KDB 935210 D05 clause 4.8 FCC PART 2.1055(a)(2) FCC PART 90.213 FCC PART 90.219 (e)(4)(i)	KDB 935210 D05/4.8 FCC PART 2.1055(b)	☒	
Radiated spurious emissions	KDB 935210 D05 clause 4.9 FCC PART 2.1053 FCC PART 90.219 (e)(3)	KDB 935210 D05 clause 4.9 ANSI C63.26-2015/5.5 ANSI/TIA 603-E-2016 ANSI/TIA-102.CAAA-E-2016	☒	

NOTE: ☒ mean that test needs to be performed.

5. About Signal Booster

According to the basic information of EUT (the device is a broadband device) and FCC part 90.219 (a) and KDB 935210 D02 APPENDIX A3.1 rules, this EUT belongs to PART 90 class A Industrial signal booster and it is a non SMR.

5.1. KDB 935210 D02 APPENDIX A3.1

A.3.1 Signal Booster (Section 90.219)

A **Signal Booster (Section 90.219)** is a device or system that automatically receives, amplifies, and retransmits signals from wireless stations into and out of building interiors, tunnels, shielded outdoor areas and other locations where these signals would otherwise be too weak for reliable communications. Signal booster systems may contain both Class A and Class B signal boosters as components. [Section 90.219(a)]

All **Section 90.219 boosters** are a type of Industrial Signal Booster, and are classified as either **Class A boosters** (narrowband) or **Class B boosters** (wideband). [R11] [Order, ¶ 15]

Note also that Consumer Signal Boosters are not defined for PLMRS or PSRS because licensees are considered to operate private services. Part 90 PLMR licensees typically obtain authorizations for individual narrowband channels or groups of channels to satisfy their own communication needs. Moreover, many Part 90 channels are interleaved and a licensee's channels may not be adjacent to one another, which presents unique considerations for signal boosters used with Part 90 PLMR services. [Order, ¶ 144]

a) Class A signal booster: A signal booster designed to retransmit signals on one or more specific channels. A signal booster is deemed to be a Class A signal booster if none of its passbands exceed 75 kHz. [Section 90.219(a)]

b) Class B signal booster: A signal booster designed to retransmit any signals within a wide frequency band. A signal booster is deemed to be a Class B signal booster if it has a passband that exceeds 75 kHz. [Section 90.219(a)]

Class B signal boosters may be deployed only at fixed locations; mobile operation of Class B signal boosters is prohibited (after November 1, 2014). [Section 90.219(d)(4)]

Except for signal boosters incorporating distributed antenna systems (DAS) and installed in buildings, the passband of a Class B booster shall not encompass both commercial services (such as ESMR and Cellular Radiotelephone) and Part 90 Land Mobile and Public Safety Services. [Section 90.219(d)(7)]

5.2. FCC part 90.219 (a) Definitions

§90.219 Use of signal boosters.

This section contains technical and operational rules allowing the use of signal boosters in the Private Land Mobile Radio Services (PLMRS). Rules for signal booster operation in the Commercial Mobile Radio Services under part 90 are found in §20.21 of this chapter.

<https://www.ecfr.gov/cgi-bin/text-idx?SID=2097cbecde8abb94d012e95530a44e05&mc=true&node=pt47.5.90&rgn=div5>

2020/6/15

Electronic Code of Federal Regulations (eCFR)

(a) *Definitions.* The definitions in this paragraph apply only to the rules in this section.

Class A signal booster. A signal booster designed to retransmit signals on one or more specific channels. A signal booster is deemed to be a Class A signal booster if none of its passbands exceed 75 kHz.

Class B signal booster. A signal booster designed to retransmit any signals within a wide frequency band. A signal booster is deemed to be a Class B signal booster if it has a passband that exceeds 75 kHz.

6. Test modes

Test modes	TX mode: “DOWNLINK INPUT” port of EUT is connected to the signal generator, “DOWNLINK OUTPUT” port is connected to the spectrum analyzer through attenuator, and the power of the EUT is turned on and signal is sent. RX mode: “UPLINK INPUT” port of EUT is connected to the signal generator, “UPLINK OUTPUT” port is connected to the spectrum analyzer through attenuator, and the power of the EUT is turned on and signal is sent.
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7. Laboratory

The tests & measurements refer to this report were performed by GRG METROLOGY & TEST (CHENGDU) CO., LTD.

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8. Measurements uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

Measurement		Frequency	Uncertainty
Radiated Spurious Emission	Horizontal	30MHz~1000MHz	4.8dB
	Horizontal	1GHz~18GHz	5.1dB
	Vertical	30MHz~1000MHz	4.9dB
	Vertical	1GHz~18GHz	5.0dB

Measurement	Uncertainty
RF frequency accuracy	6.0×10^{-6}
RF power conducted	0.60dB
Occupied channel bandwidth	0.40%
Unwanted emission, conducted	0.66dB
Humidity	6.0%
Temperature	2.0°C

Note: This uncertainty represents an expanded uncertainty factor of $k=2$.

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9. Instruments used during test

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Vector Signal Generator	R&S	SMW200A	110473	2024-08-11
Vector Signal Generator	R&S	SMBV 100B	101965	2024-07-12
Vector Signal Generator	R&S	SMBV 100A	260996	2024-10-16
Signal Generator	Agilent	E5182A	MY46240077	2024-09-21
Spectrum analyzer	R&S	FSV30	103264	2024-08-23
Spectrum analyzer	R&S	FSW43	102249	2024-07-15
Spectrum analyzer	Keysight	N9010B-503	MY56460128	2024-10-27
SNS Series Noise Source	Agilent	N8975A	MY45272551	2024-11-08
SNS Series Noise Source	Agilent	N4000A	MY53232432	2025-02-21
Frequency meter	Suin	SS7300	6E5042029	2024-09-14
Digital multimeter	Fluke	F15B+	44750292WS	2024-11-08
Attenuation	Shanghaihua xiang	DTS10-40-4BNCJK	18112301	2024-08-08
Temp & Humidity chamber	OTS	ZB-TY800II	180810001	2024-06-19
Radiated Spurious emissions				
Receiver	R&S	ESU40	100106	2024-08-30
Receiver	R&S	ESU40	100515	2024-11-03
Bi-log Antenna	Schwarzbeck	VULB 9168	01303	2024-07-22
Bi-Log Antenna	SCHWARZBECK	VULB 9163	01175	2024-09-03
Horn antenna	SCHWARZBECK	BBHA 9120D	01668	2025-12-03
Horn Antenna	SCHWARZBECK	BBHA 9120D	02492	2024-07-15
Horn Antenna	ETS	3117 C	00075824	2024-12-02
Broadband Amplifiers	SCHWARZBECK	BBV9718	00246	2024-11-08
Broadband Amplifiers	SCHWARZBECK	BBV9745	9745#76	2025-02-01
Preamplifier	KEYSIGHT	HLWLNA-10180	15128009	2025-02-01
Semi-anechoic chamber	ETS-lindgren	966(RFD-F/A-100)	3730	2026-09-12

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10. Radio technical requirement specification

10.1. Test Frequencies

Test requirement: KDB 935210 D02 APPENDIX D/Table D.3
FCC PART 2.1057
ANSI C63.26-2015 Clause 5.1.2

10.1.1. Requirements

According to FCC regulations, FCC part 2.1057, ANSI C63.26-2015 clause 5.1.2 and KDB 935210 D02 Appendix D / table D.3 have relevant frequency band requirements.

(1) FCC PART 2.1057

§2.1057 Frequency spectrum to be investigated.

(a) In all of the measurements set forth in §§2.1051 and 2.1053, the spectrum shall be investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to at least the frequency shown below:

(1) If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

(2) If the equipment operates at or above 10 GHz and below 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.

(3) If the equipment operates at or above 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 200 GHz, whichever is lower.

(b) Particular attention should be paid to harmonics and subharmonics of the carrier frequency as well as to those frequencies removed from the carrier by multiples of the oscillator frequency. Radiation at the frequencies of multiplier stages should also be checked.

(c) The amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.

(d) Unless otherwise specified, measurements above 40 GHz shall be performed using a minimum resolution bandwidth of 1 MHz.

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