



SHURE

ELECTROMAGNETIC COMPATIBILITY LABORATORY

TEST REPORT

TEST REPORT TITLE: Modulation Characteristics for Shure PA421B, PA421BX, PA821B, PA821BX Antenna Combiners

TEST ITEM DESCRIPTION:

The PA421B, PA821B, PA421BX, and PA821BX are UHF-band antenna combiners designed to combine the outputs of multiple personal stereo monitor (PSM) transmitters to a single antenna output. The products operate across the authorized UHF bands spanning the range of 470 to 960 MHz. The combiners feature a half-rack metal enclosure, and are designed to be used in professional sound installations to eliminate the clutter of antennas from multiple wireless PSM transmitters.

For: Shure Incorporated
5800 West Touhy Avenue
Niles, IL 60714

Project ID Number: SEL-026

Date Tested: March 2, 2017 – March 14, 2017

Test Personnel: Alex Stelmazczyk, Tom Braxton

Test Specification: FCC Code of Federal Regulations Title 47 Part 74
ISED RSS-210
ISED RSS-Gen

TEST REPORT BY:	<u><i>Thomas E. Braxton</i></u> SIGNATURE	<u>GLOBAL COMPLIANCE PROJ. ENGR.</u> POSITION	<u>3/16/17</u> DATE
APPROVED BY:	<u><i>Clay Kozlowski</i></u> SIGNATURE	<u>GLOBAL COMPLIANCE ENGINEER</u> POSITION	<u>3/16/2017</u> DATE

TABLE OF CONTENTS

PARAGRAPH	DESCRIPTION OF CONTENTS	PAGE NO.
0.	Report Revision History	4
1.	Introduction	5
1.1.	Scope of Tests	5
1.2.	Purpose	5
1.3.	Deviation, Additions and Exclusions	5
1.4.	EMC Laboratory Identification	5
1.5.	Summary of Tests Performed	5
2.	Applicable Documents	6
3.	EUT Setup and Operation	6
3.1.	General Description	6
3.2.	Test Samples	6
3.3.	Test Setup	7
3.3.1.	Power Input	7
3.3.2.	Signal Input/Output Leads	7
3.3.3.	Antenna Ports	7
3.3.4.	Test Frequency Range	7
3.3.5.	Grounding Considerations	7
3.4.	Operational Mode	7
4.	Test Instrumentation	7
5.	Test Procedures	7
6.	Other Test Conditions	7
6.1.	Test Personnel and Witnesses	7
6.2.	Disposition of the EUT	7
7.	Results of Tests	7
8.	Conclusions	8
9.	Certification	8
10.	Equipment List	8
11.	Appendix A - Modulation Characteristics	9

Note: This report shall not be reproduced, except in full, without the written approval of the Shure Incorporated Electromagnetic Laboratory (SEL). Total Page Count, including appendices is 16.

LIST OF APPENDICIES

APPENDIX	TEST DESCRIPTION
A	MODULATION CHARACTERISTICS



REPORT REVISION HISTORY

Revision	Date	Description
0	3/16/17	Initial Release

Report Title:

1. INTRODUCTION

1.1. Scope of Tests

This document presents the results of tests to record the modulation characteristics of the Shure PA421B, PA421BX, PA821B, and PA821BX antenna combiners. The test items were manufactured and submitted for testing by Shure Incorporated in Niles, Illinois. The data was taken following the measurement methods as described in this document's test specifications. Provided also is information on the test samples, a summary of the measurements made, and a description of the measurement setup. The EUTs comprise a family of antenna combiners designed to emit in the following UHF frequency ranges using an external, removable dipole antenna:

Models	Available Frequency Range (MHz)
PA421B, PA821B	470 - 865
PA421BX, PA821BX	865 - 960

1.2. Purpose

This series of tests was performed to determine if the test items would meet the modulation specifications of the FCC Code of Federal Regulations Title 47 Part 74, Subpart H, Section 74.861. The test series was also performed to determine if the test items meet the radiated and conducted RF emission specifications of ISED RSS-210, Amendment 1, Sections 5 and 6. Testing was performed in accordance with ANSI C63.4-2003 and RSS-GEN.

1.3. Deviations, Additions and Exclusions

None.

1.4. EMC Laboratory Identification

The tests were performed at the Shure Electromagnetic Laboratory, Shure Incorporated, 5800 West Touhy Ave, Niles, Illinois 60714-4608. This laboratory is registered with ISED (Canada) as Site # 616A-1. The Shure Electromagnetic Laboratory is accredited by the National Institute of Standards and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP). The NVLAP Lab Code is: 200946-0.

1.5. Summary of Tests Performed

The following electromagnetic compatibility tests (Table 1) were performed on the EUT in accordance with FCC "Code of Federal Regulations" Title 47 Part 74 and Industry Canada RSS-210 specifications:

Table 1: Summary of tests performed

Test Spec (STD)	Description	Described in Appendix	Test Results
FCC Part 74 (74.861) RSS-210, A1 (5.3.2)	Modulation Characteristics	A	PASS

2. APPLICABLE DOCUMENTS

The following documents of the exact issue designated form part of this document to the extent specified herein:

- Federal Communications Commission "Code of Federal Regulations", Title 47, Part 74, dated 1 October 2010
- Federal Communications Commission "Code of Federal Regulations", Title 47, Part 2, dated 1 October 2010
- RSS-210, Issue 8 (Dec., 2010) - License-exempt Radio Apparatus (All Frequency Bands): Category I Equipment
- RSS-210, Amendment 1 (Feb., 2015)— License-Exempt, Low-Power Radio Apparatus Operating in the Television Bands
- RSS-Gen, "Spectrum Management and Telecommunications Radio Standards Specification General Requirements and Information for the Certification of Radiocommunication Equipment", Issue 4, November 2014
- 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"
- TIA-603-C-2004, "Land Mobile FM or PM Communications Equipment Measurement and Performance Standard"

3. EUT SET-UP AND OPERATION

3.1. General Description

The EUTs antenna combiners, model numbers PA421B, PA421BX, PA821B, and PA821BX. The arrangement in which the testing was conducted can be found in the appendix.

3.2. Test Samples

The following product sample was tested:

Model	Frequency Range (MHz)	Serial #
PA421B	470 - 865	DM3-C2
PA421BX	865 - 960	DM3-D4
PA821B	470 - 865	DM3-A2
PA821BX	865 - 960	B2-DM3

3.3. Test Setup

3.3.1. Power Input

The EUT was powered with 120VAC.

3.3.2. Signal Input /Output Leads

To capture modulation characteristics across the EUTs' range of frequencies, Shure P10T transmitters were used as inputs to the combiners.

3.3.3. Antenna Ports

The antenna output port was connected to the test instruments as described in the appendix.

3.3.4. Test Frequency Range

Three frequencies representing the low, mid, and high frequencies in the usable range of the combiners were chosen: 506 MHz, 662 MHz, and 948 MHz.

3.3.5. Grounding Considerations

The EUT was grounded during testing via the AC mains safety ground.

3.4. Operational Mode

Frequency and Power Output:

All tests were performed separately in the following transmit frequency and output power modes:

Tx @ 506 MHz, 100 mW (Low)

Tx @ 662 MHz, 100 mW (Mid)

Tx @ 948 MHz, 100 mW (High)

4. TEST INSTRUMENTATION

A list of the test equipment used can be found in table 10-1. All equipment used was within calibration terms during and throughout the duration of the tests. All calibrations are traceable to the National Institute of Standards and Technology (NIST).

5. TEST PROCEDURES

The specific test procedures are presented in the appendix.

6. OTHER TEST CONDITIONS

6.1. Test Personnel

All EMC tests were performed by qualified personnel from the Shure EMC Laboratory.

6.2. Disposition of the EUT

The EUTs and all associated equipment were returned to Shure Incorporated upon completion of the tests.

7. RESULTS OF TESTS

The results are presented in the test appendix. It was found that the Shure Incorporated antenna combiners met the modulation deviation requirements of the FCC Code of Federal Regulations Title 47, Part 74, Subpart H, Section 74.861. It was also found that the PA421B and PA821B met the radiated and conducted RF emissions specifications of ISSED RSS-GEN, Sections (7.1.3), (8.8), (8.9) and RSS-210 Amendment 1.

8. CONCLUSIONS

It was determined that the Shure Incorporated PA421B, PA421BX, PA821B, and PA821BX did fully comply with the modulation characteristics requirements of the FCC Code of Federal Regulations Title 47 Part 74, Subpart H, Section 74.861. The PA421B and PA821B met the ISED RSS-210, RSS-GEN, Sections (7.1.3), (8.8), (8.9) and RSS-210 Amendment 1.

CERTIFICATION

Shure EMC Laboratory certifies that the information contained in this report was obtained under conditions which meet or exceed those specified in the test specifications.

The data presented in this test report pertains to the EUTs at the test date. Any electrical or mechanical modification made to the EUTs subsequent to the specified test date will serve to invalidate the data and void this certification.

This report must not be used to claim product endorsement by NVLAP or any agency of the US Government.

9. EQUIPMENT LIST

Table 9-1: Test Equipment

L# or ID	Description	Manufacturer	Model #	Serial #	Calibration Due Date
L05-068-02	Modulation Analyzer	Boonton	8200	24602BH	10/15/2017
L23-021-01	Audio Analyzer	Audio Precision	2722-192K	SYS2-32230	10/15/2017

A. MODULATION CHARACTERISTICS

G.1. PURPOSE:

This test was performed to determine if the PA421B, PA421BX, PA821B, and PA821BX family of antenna combiners meets the deviation requirements of FCC Part 74, and if the PA421B and PA821B meets the requirements of RSS-210, A1.

G.2. REQUIREMENTS:

As stated in paragraph 74.861(e)(3) and paragraph 6.6.2 of RSS-210, Amendment 1, for low power auxiliary stations operating in the bands allocated for TV broadcasting, any form of modulation may be used. A maximum deviation of $\pm 75\text{kHz}$ is permitted when frequency modulation is employed.

G.3. TEST SETUP AND INSTRUMENTATION:

A photograph of the test setup is shown as Figure A-1. The test instrumentation can be determined from Table 9-1.

G.4. EUT OPERATION:

The EUT was powered up and the transmit frequency of the appropriate P10T transmitter was selected using the P10T front panel controls. The EUT was checked for proper operation after it was setup for the test. The EUTs were set to transmit at a low, mid or high frequency within the combiners' operating range. The power level of the P10T transmitter at each frequency was set to the 100 mW.

G.5. TEST PROCEDURES:

The output of the antenna port of the test item was connected to a modulation analyzer. An audio signal generator was connected to the audio input port of the transmitter generating the test signal.

- a) The test item was modulated with a 1000 Hz modulating signal at 60% of the test items rated frequency deviation.
- b) With input level held constant the audio signal generator was varied from 20 Hz to 20 kHz.
- c) The positive and negative peak deviations were recorded and plotted.

The output of the antenna port of the test item was connected to a modulation analyzer. An audio signal generator was connected to the audio input port of the transmitter generating the test signal.

- a) The modulation response was measured separately across a range of audio frequencies.
- b) The input voltage of the audio signal generator was varied and frequency deviation was observed on the modulation analyzer.
- c) The frequency deviations were recorded and plotted.

G.6. RESULTS:

The plots of the modulation characteristics are presented on Pages 11-16. Data results are shown on the figures at each band. As can be seen from the data presented in the section, the antenna combiners did meet the permitted maximum deviation requirements.

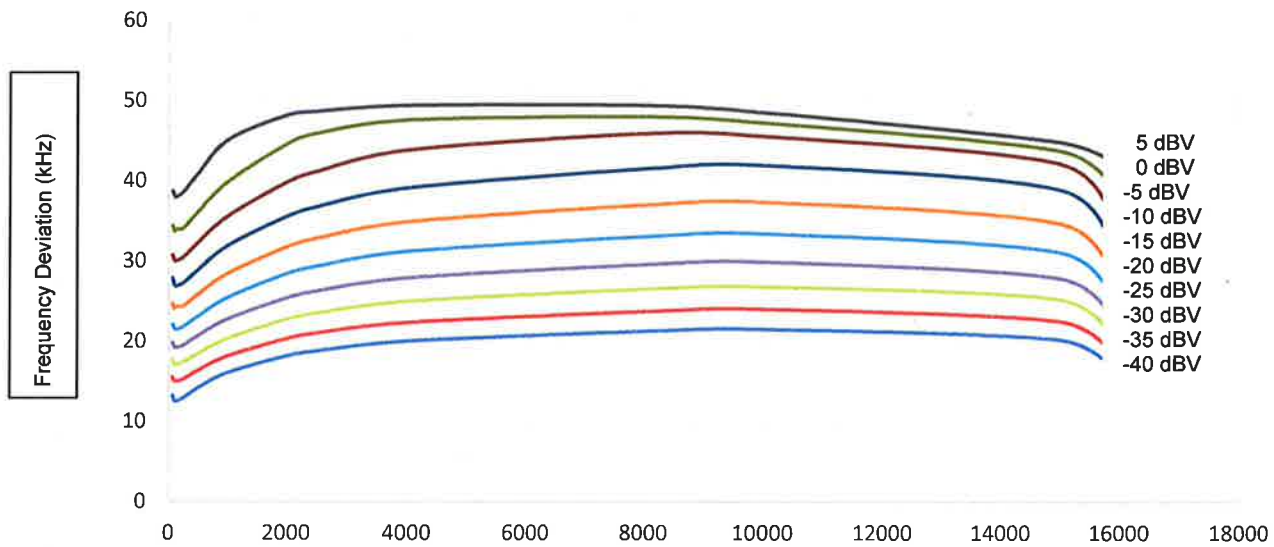
Appendix A



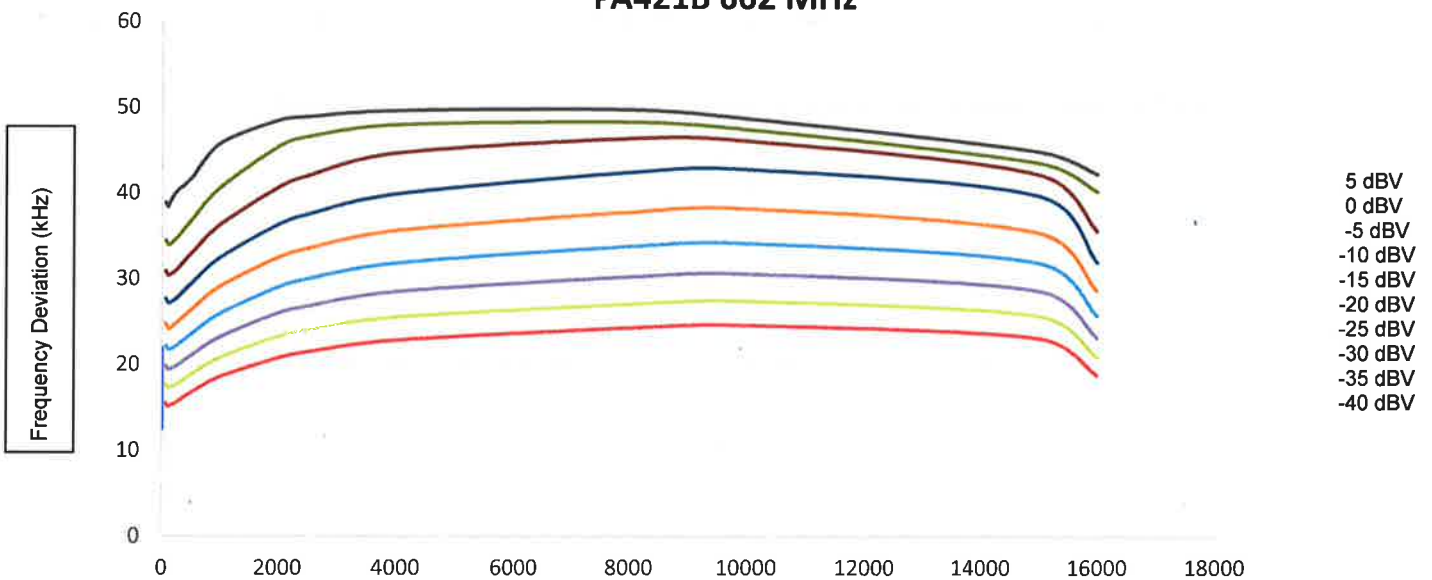
Figure A-1 Setup of Modulation Characteristic Measurements

Deviation vs. Frequency

PA421B 506 MHz

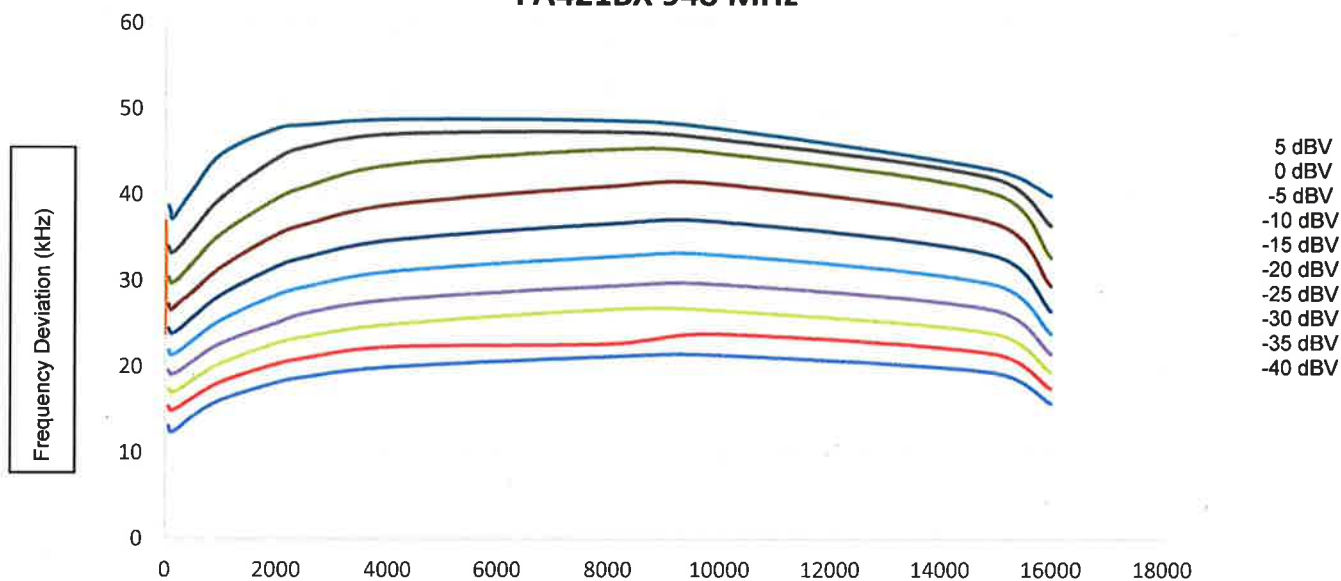


PA421B 662 MHz

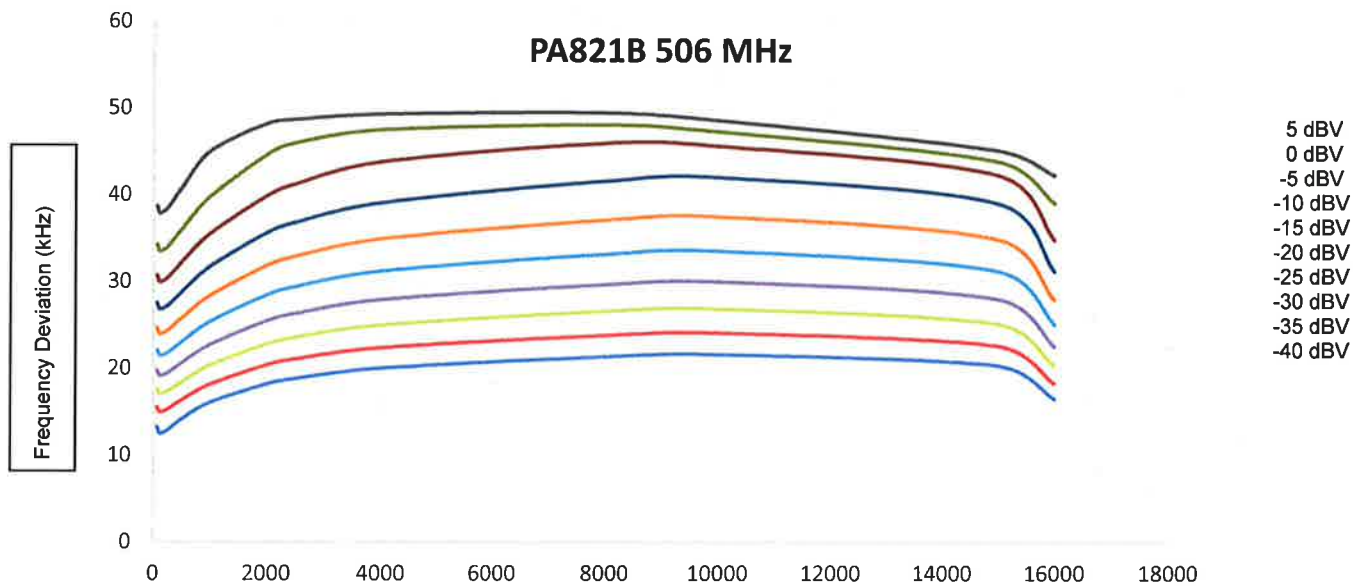


AppendixA

PA421BX 948 MHz

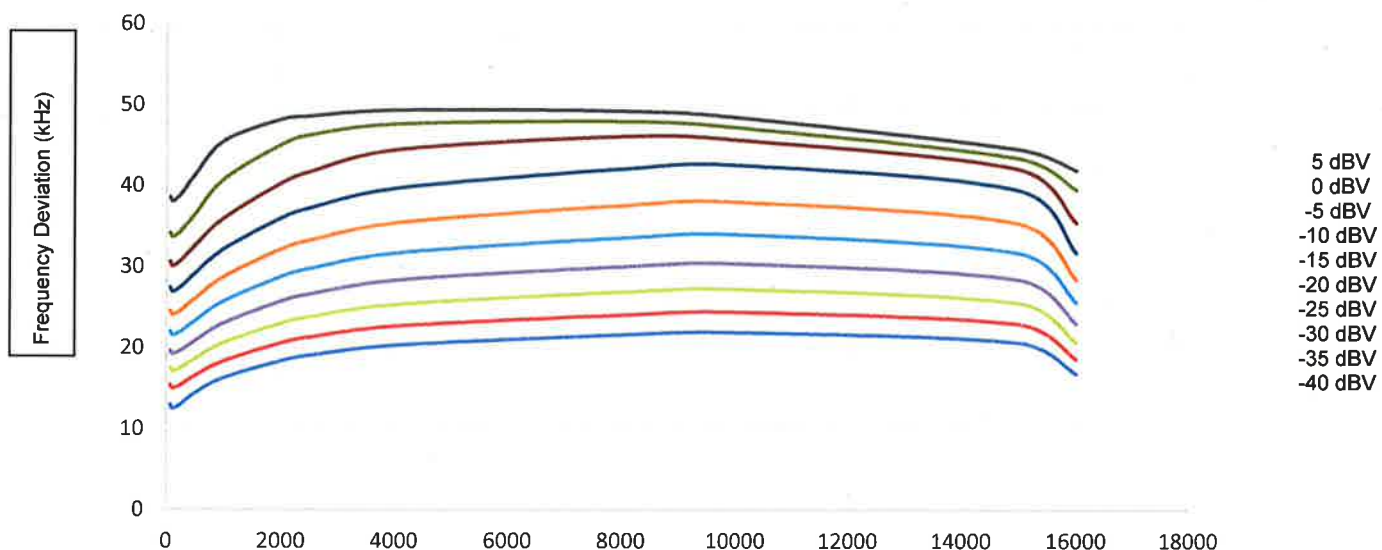


PA821B 506 MHz

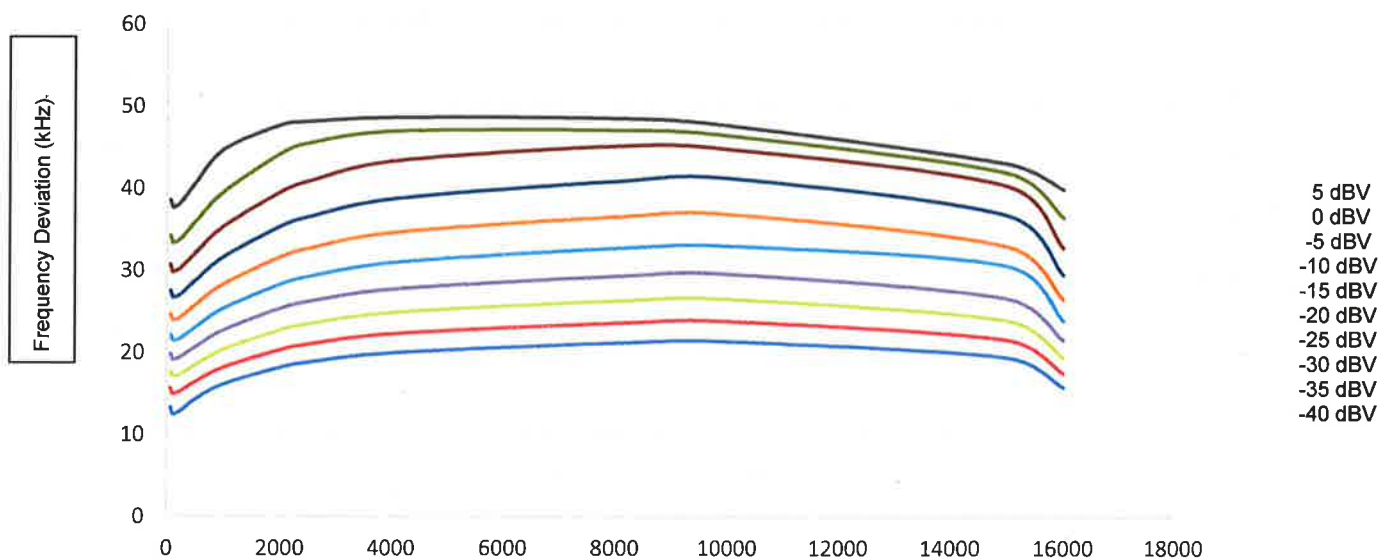


AppendixA

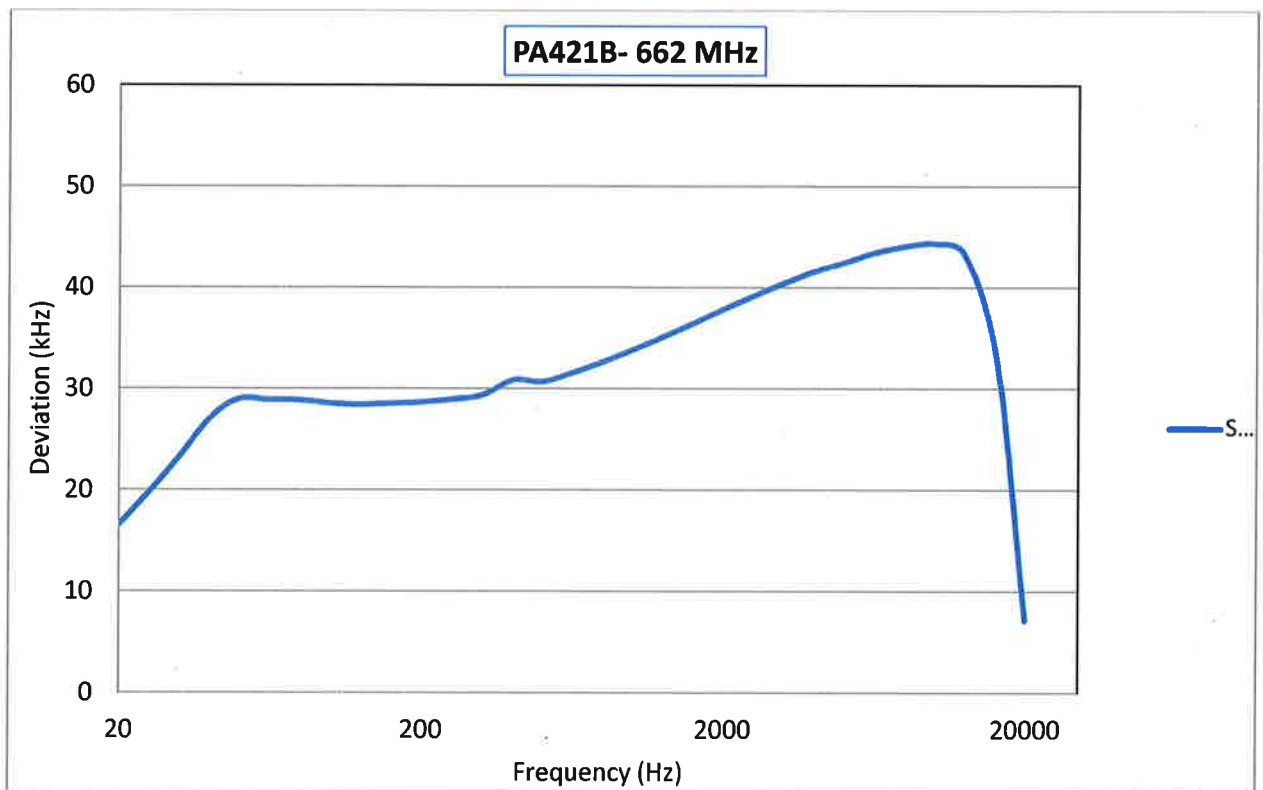
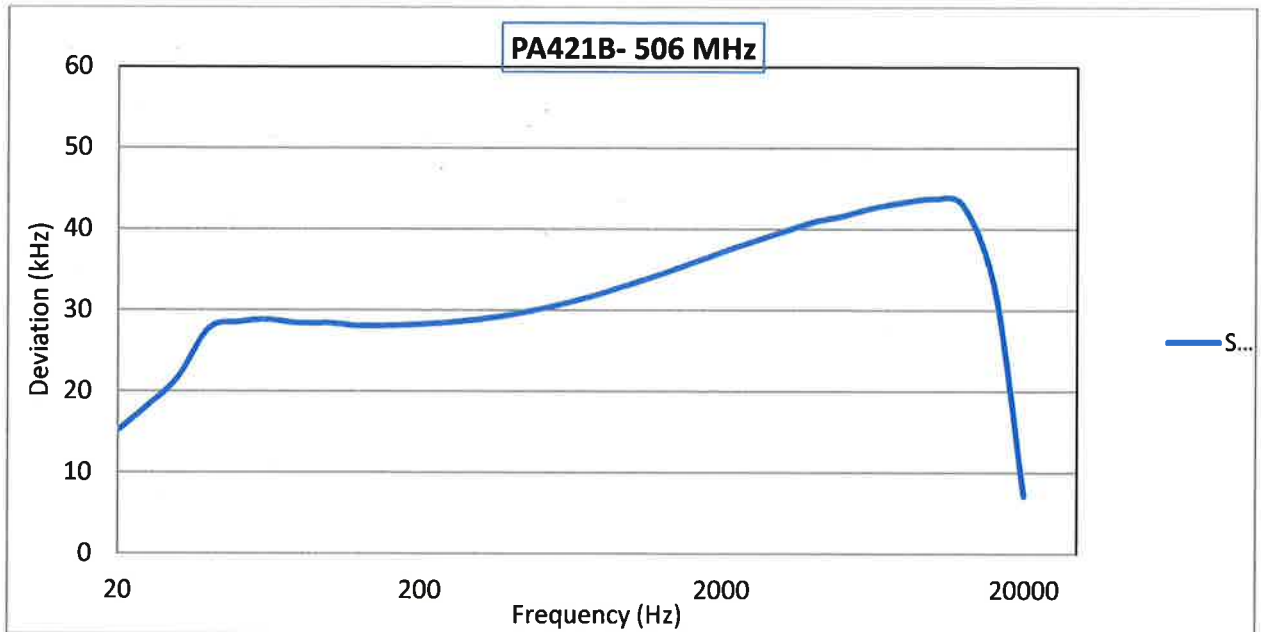
PA821B 662 MHz



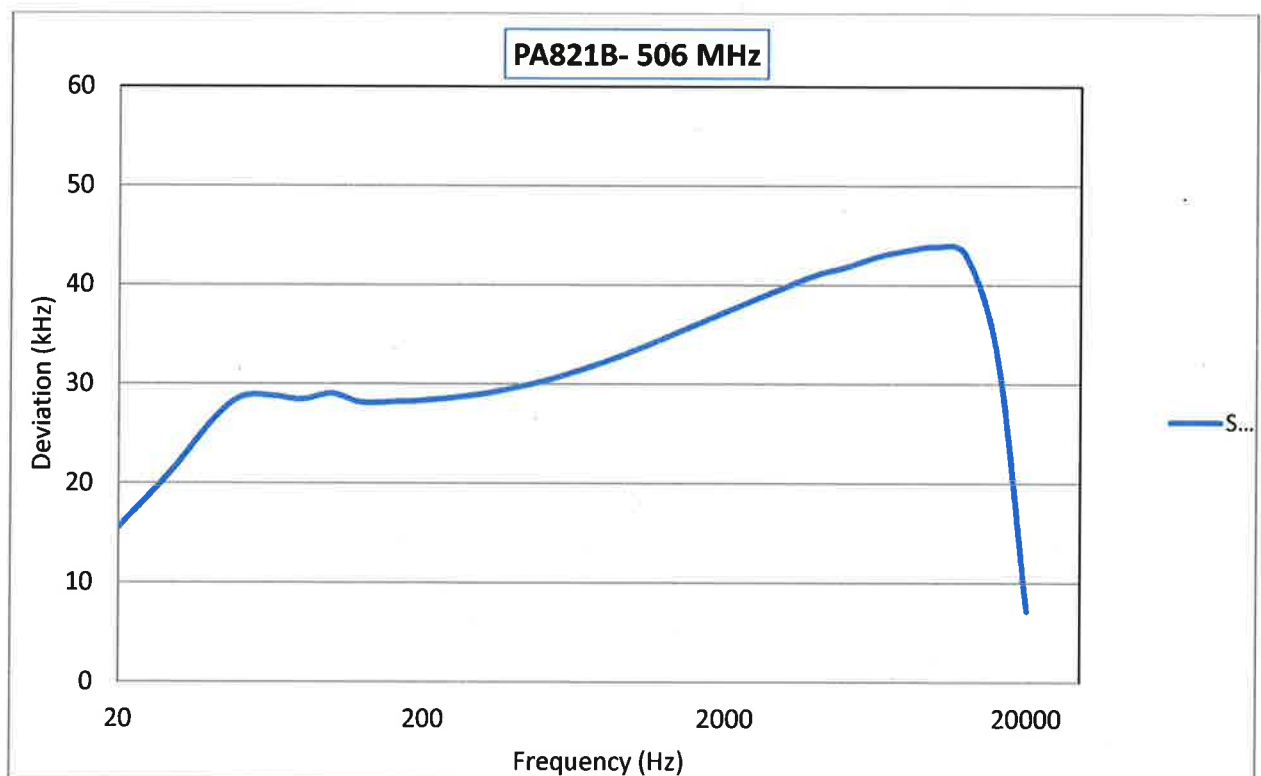
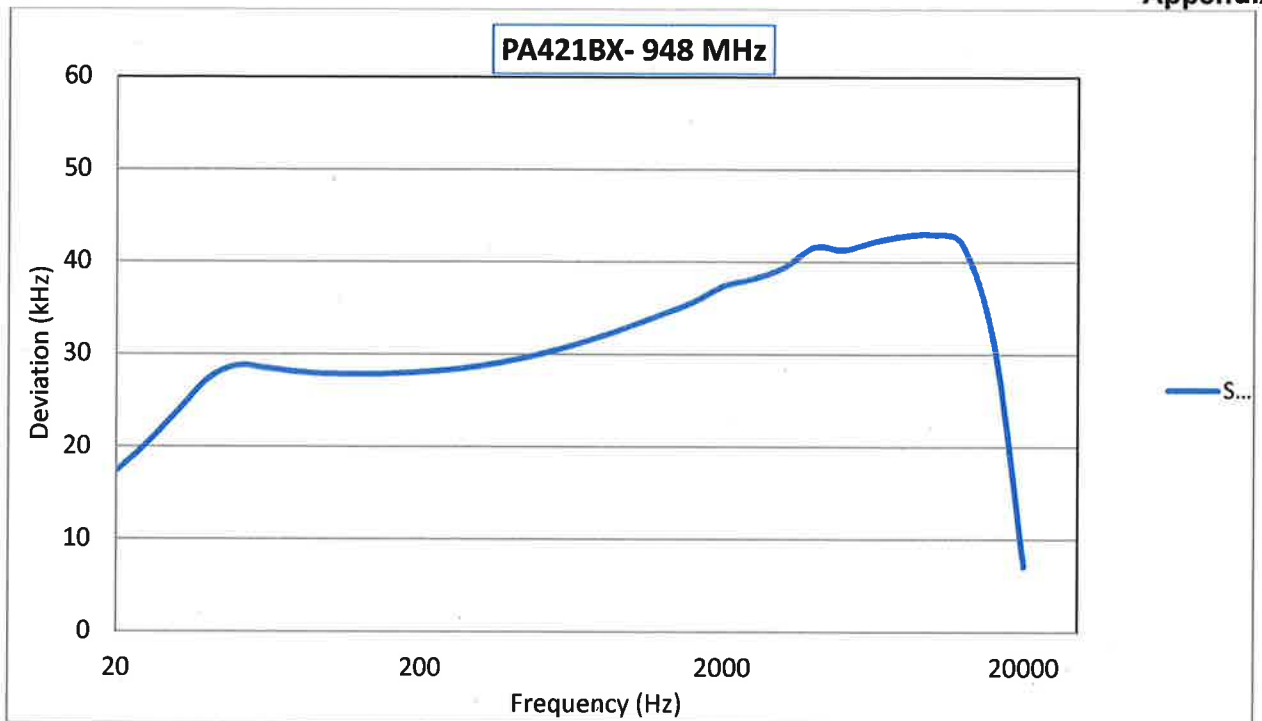
PA821BX 948 MHz



Deviation vs Input



Appendix A



AppendixA

