FM Combiner Proof

for the combined operation of:

KNIN-FM / KWFS-FM / KBZS-FM Main Facilities
KNIN-FM 225C1 / 92.9 MHz, Wichita Falls, TX / FID 43754
KWFS-FM 272C1 / 102.3 MHz, Wichita Falls, TX / FID 1722
KBZS-FM 292C2 / 106.3 MHz, Wichita Falls, TX / FID 52074

Location Address:
Site entrance east off of Barnett Rd,
1 km north of Seymour Hwy (BUS US-277),
Wichita Falls, TX

Tower Coordinates:
33-53-18.0 N 98-34-09.0 W (NAD 83)
ASRN: 1052224

Measurements Recorded
February 9, 2024

Prepared By	Prepared For
Wavepoint Research, Inc. Wavepoint Research, Inc. PO Box 680521 Franklin, TN 37068 Eric Wandel, PE eric@wavepointresearch.com 812-453-2544 (mobile)	**Townsquare Media – Wichita Falls** 2525 Kell Blvd., Suite 200 Wichita Falls, TX, 76308 Ed Dulaney, Regional Engineering Manager (Texas/Oklahoma/Louisiana/Arkansas) Mobile: 940-733-4174 Email: Ed.Dulaney@townsquaremedia.com

Table of Contents

List of Figures

List of Tables

1 Introduction

This report of findings provides evidence to show that the operation of the combined FM facility for KNIN-FM (92.9 MHz), KWFS-FM (102.3 MHz) and KBZS-FM (106.3 MHz) located at tower ASRN 1052224 in Wichita Falls, Texas, is in compliance with the FCC Rules and Regulations as required by the Code of Federal Regulations (CFR) Title 47 Sections 73.317 (a) thru (d) (attached as Exhibit A), and specifically as related to potential intermodulation products that may occur and must typically be below the limit specified by 73.317 paragraph (d).

Intermodulation (IM) products can potentially violate section 73.317 paragraph (d) requirements and may be generated from radio stations operating into multiplexed facilities and at congested antenna broadcast sites when inadequate transmitter-to-transmitter isolation is provided. The mechanics associated with the phenomenon have been well documented. When two or more transmitters are coupled to each other, new spectral components are produced by the mixing of the station frequencies in the active circuits of each transmitter.

The common term used to describe the most likely occurrence of this phenomenon is “third order product” denoted by the mathematical expression [2(F1)-(F2)], where F1 signifies the frequency of the transmitter that is generating the intermodulation product, and F2 signifies the frequency causing the interference. The installed filter / combiner system for the combined operation of KNIN, KWFS and KBZS was designed to provide adequate isolation between transmitters as well as to provide filtering of potential outgoing intermodulation products to ensure compliance with section 73.317.

In brief, the collection of measurements presented in this report establishes that IM products generated by the operation of these stations are less than the maximum allowable level as required by section 73.317(d), and additional exhibits are provided to also show compliance with sections 73.317(b) and (c). During measurements, all stations were operating at full ERP simultaneously utilizing the shared antenna as described herein.

2 Transmission System

The combined system is comprised of the three main FM transmitters, an ERI three-station 783-3 series filter/combiner and an ERI 12-bay model SHPB-12C6-SP sidemounted antenna.

The installed filter/combiner system is designed to provide adequate isolation to ensure that interfering signals and any resulting intermodulation products are sufficiently attenuated to satisfy the section 73.317 paragraph (d) requirement. The combiner system consists of three 3-cavity filter modules (one module per station) combined as a manifold combiner into the common antenna.

The transmitter and filter module information is provided in Table 1 along with power levels for each station. All stations operated at listed TPO for the duration of compliance measurements.

Table 1 – Combiner System Information, Station Power Levels

Call Sign	**KNIN-FM**	**KWFS-FM**	**KBXS-FM**
Channel / Frequency (MHz)	**225C1 / 92.9**	**272C1 / 102.3**	**292C2 / 106.3**
FCC Facility ID	43754	1722	52074
Transmitter	GatesAir FAX 20K P/N: HARFAX20KFAx50 S/N: TE10006738-001	GatesAir FAX 20K P/N: HARFAX20KFAx50 S/N: TE10005501-001	GatesAir FAX 10K P/N: HARFAX10KFAx50 S/N: TE10006670-001
ERP (kW)	100	100	50
TPO (kW) Rounded per 47CFR73.212 *[At transmitter output before filter/ combiner losses]*	19.0	17.0	10.1

A drawing of the combiner layout is shown in Figure 1. A photo of the ERI directional coupler line section installed at the output of the combiner system is shown in Figure 2. It is a dual port 6-1/8" directional coupler, Part # CD651-2-NN00, S/N 40054A-110923-2, with coupling ports having the following characteristics at 98 MHz:

- DC1: Coupling -51.88 dB, Directivity -41 dB
- DC2: Coupling -60.4 dB, Directivity -36.87 dB

The DC2 port was used as the sample location for all spectral compliance measurements recorded in this report.

The combined output feeds a side mounted FM antenna, ERI model SHPB-12C6-SP. A photo of the antenna is shown in Figure 3.

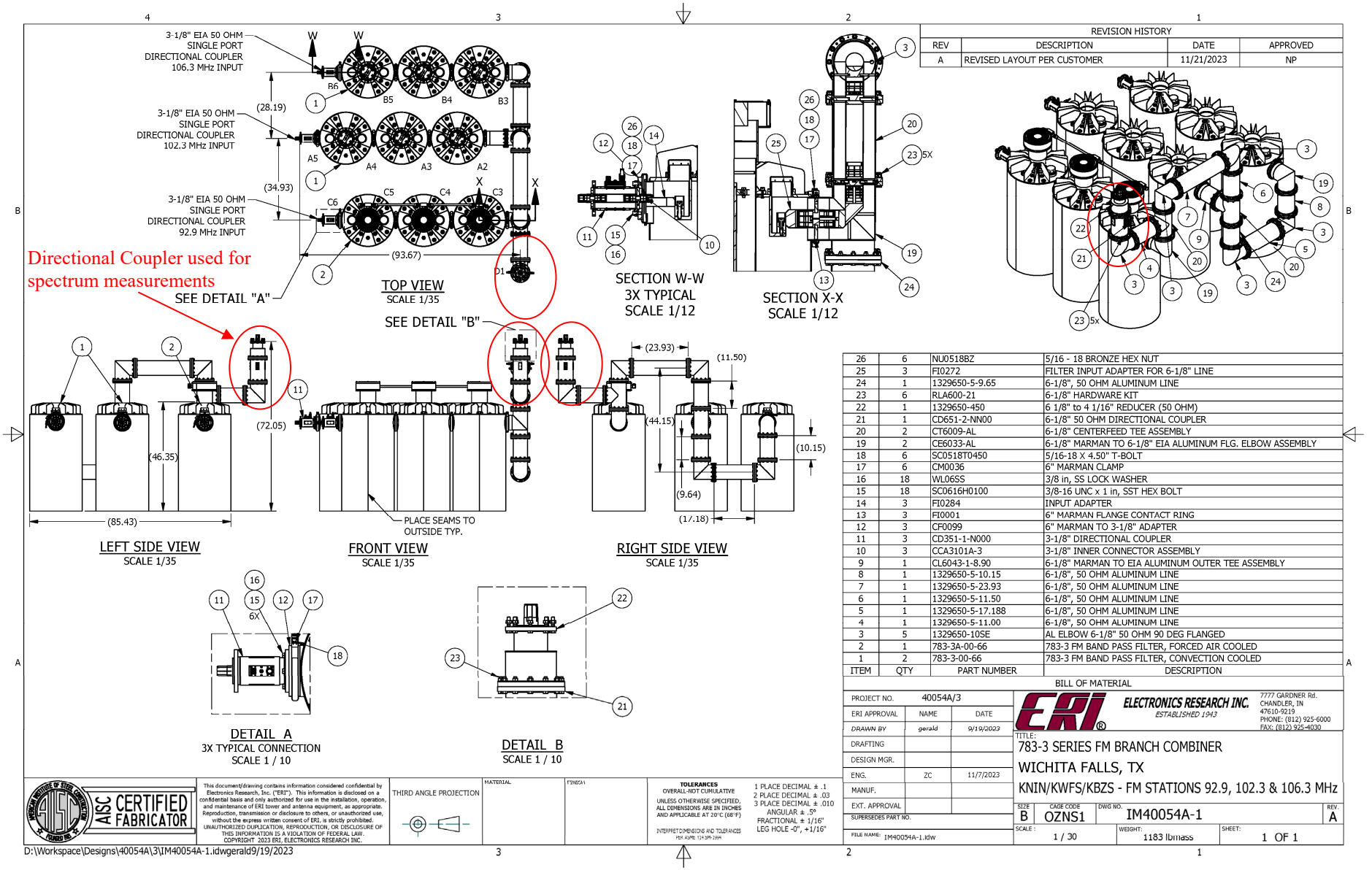

Figure 1 – Combiner System Layout Showing Location of Directional Coupler Used for Data Collection

Figure 2 – Directional Coupler at Output of Combiner System

Figure 3 – Combined System Antenna, ERI Model SHPB-12C6-SP

A variety of equipment was employed to collect the data recorded herein, including:

- Anritsu SiteMaster S332E w/ Spectrum Analyzer
  - S/N: 1104062
  - Calibration date: 2021-03-01
- Copper Mountain SC5090 Vector Network Analyzer, S/N 20089230, for adjusting band pass / notch filters used for testing
- Band pass / notch filters with high selectivity, used to isolate measured signals and to suppress carrier signals
- Mini Circuits High Pass Filters
- Various attenuators and shielded test cables
- ERI 6-1/8" directional coupler
  - Part # CD651-2-NN00
  - S/N 40054A-110923-2
  - Port DC2: Coupling -60.4 dB, Directivity -36.87 dB (at 98 MHz)

Measurements to verify compliance with section 73.317 were made at the directional coupler listed above. Eric Wandel, P.E., made the measurements summarized herein on February 9, 2024, at the commission of Townsquare Media.

A diagram of the test equipment setup is shown in Figure 4.

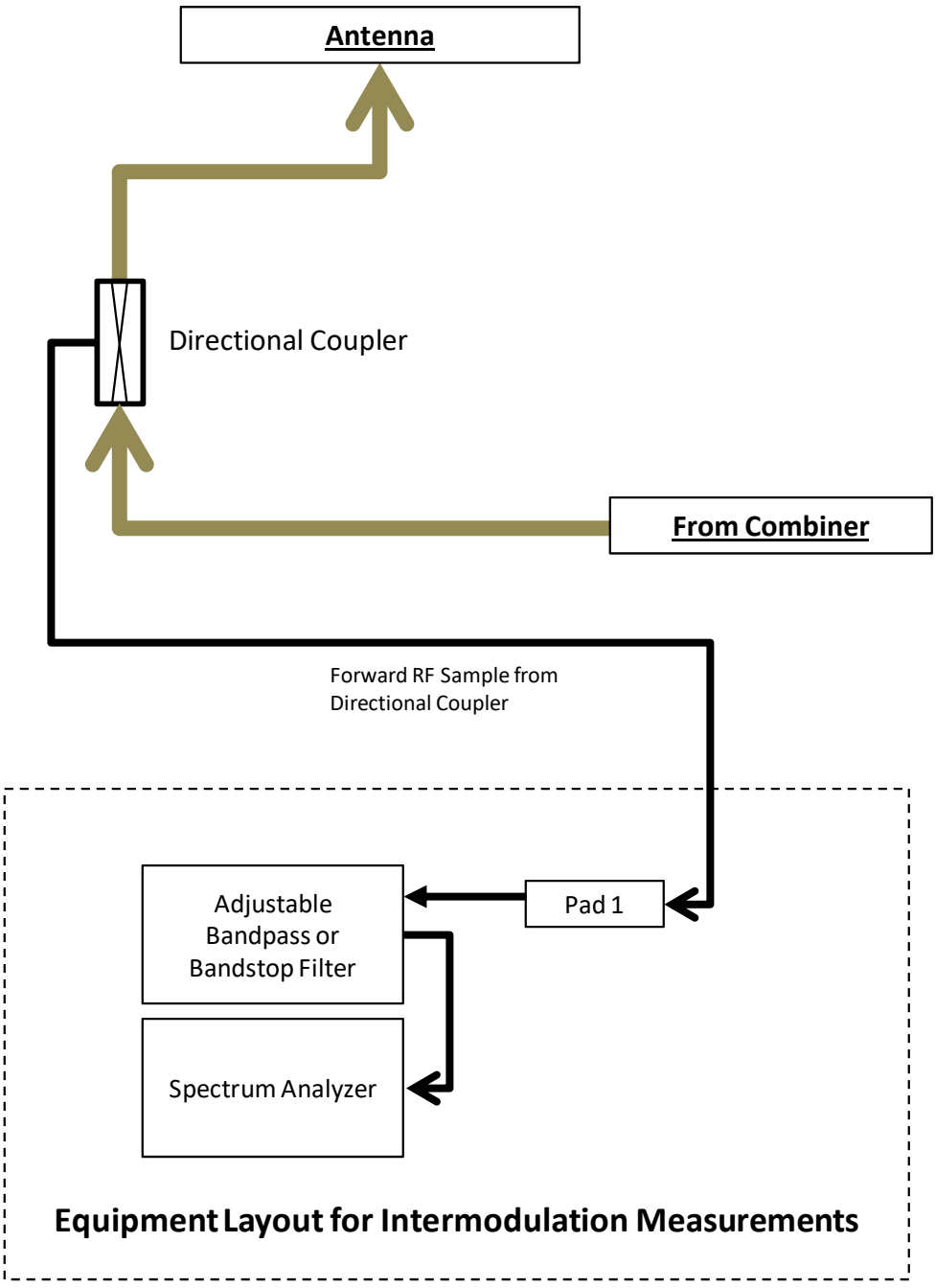

Figure 4 –Test Equipment Layout for IM Measurements

3 Product Measurements

Measurements were made to assess the level of potential intermodulation products that might exist at the output of the combined system with specific attention given to third order IM products (of the type $2F_1 - F_2$). The collection of measurements presented in this report shows that all possible third order inter-modulation (IM) products generated by the operation of the present combined stations are less than the maximum allowable level as required by section 73.317(d).

Key isolation characteristics of the filter / combiner system as previously measured are listed in Table 2. The filter suppression values from each input to the combined output are shown for 2 MHz from center frequency as a reference.

Table 2 – Measured Filter / Combiner Isolation Characteristics

Module	Port-to-Port Isolation (dB)			Filter Suppression Input-to-Output at +/- 2 MHz	
	To 92.9	To 102.3	To 106.3	-2 MHz	+2 MHz
KNIN 92.9 MHz		-81.8	-91.6	-38.2	-40.0
KWFS 102.3 MHz	-87.5		-61.3	-37.4	-39.6
KBZS 106.3 MHz	-97.6	-63.0		-37.5	-38.1

Calculations of the possible system-generated third order products are shown in Table 3. The potential interfering frequencies include other nearby FM stations that have the potential to couple into the system transmitters and cause third order products. Potential products from nearby stations that fell well beyond the -40 dB suppression levels of the filters were not further investigated as the combiner performance ensures adequate isolation.

Table 3 - Third Order IM Product Table

			F2 MHz (System Interfering Frequency)			F2 MHz (Nearby Station Interfering Frequency)									
			KNIN	**KWFS**	**KBZS**	**K202DR**	**KMOC**	**K223DE**	**KZWF**	**K242DG**	**KLUR**	**K263AK**	**KWFB (AUX)**	**KOWF**	**WQXC**
			92.9	**102.3**	**106.3**	**88.3**	**89.5**	**92.5**	**93.5**	**96.3**	**99.9**	**100.5**	**100.9**	**102.9**	**103.9**
F1 MHz (Transmitter Frequency)	**KNIN**	**92.9**		83.5	79.5	97.5	96.3	93.3	92.3	89.5	85.9*	85.3*	84.9*	82.9*	81.9*
	KWFS	**102.3**	111.7		98.3	116.3*	115.1*	112.1*	111.1*	108.3*	104.7	104.1	103.7	101.7	100.7
	KBZS	**106.3**	119.7	110.3		124.3*	123.1*	120.1*	119.1*	116.3*	112.7*	112.1*	111.7*	109.7	108.7

**These potential products fall beyond the -40 dB filter suppression levels and so were not measured*

As stated in CFR Title 47, Section 73.317, measurements of spectral emissions are compared to the level of the unmodulated carrier, so the relative output signal levels for the system carriers are measured first to establish reference levels for other measurements.

It is sometimes inconvenient to establish this carrier reference level using the actual unmodulated carrier during operation of the station. As an approximation to this, it is generally accepted that the power of the transmitter output can be estimated from the modulated signal using a 300 kHz resolution bandwidth (RBW)[1] which serves to integrate the power in the modulated signal. This method of establishing the carrier reference level is used here as a basis for comparing the potential IM product levels.

The reference signal level for each transmitter as recorded at the output directional coupler are listed in Table 4 and are used as the reference level for possible IM products.

Table 4 - Transmitter Forward Power Reference Levels

Call Sign	Carrier Frequency (MHz)	Carrier Level Displayed, 300 kHz RBW (dBm)	DC2 Coupling Level (dB)	External Attenuator (dB)	Cable Loss (dB)	Adjusted Carrier Forward Reference Level (dBm)
KNIN	92.9	-9.83	-60.54	20	-0.68	71.4
KWFS	102.3	-9.47	-60.54	20	-0.71	71.8
KBZS	106.2	-11.61	-60.54	20	-0.72	69.7

The IM product measurements recorded are listed in Table 5. The signal level referenced to the carrier level is shown in the third-to-last column, and the margin is shown in the last column.

All third order product levels for the combined system meet requirements.

Measurements of station harmonic levels through the eleventh harmonics were also recorded using two high pass filters in the test setup to suppress the carrier signals as seen by the spectrum analyzer. The recorded levels are provided in Table 6.
.

All harmonic levels met the CFR Title 47, Section 73.317(d) requirements.

[1] *NRSC-G201-A, NRSC-5 RF Mask Compliance: Measurement Methods and Practice,* National Radio Systems Committee, April 2010.

Table 5 - Product Measurements – KNIN / KWFS / KBZS Combined System

Carrier Frequency (MHz)	Interfering Frequency (MHz)	Product Frequency (MHz)	Directional Coupler Coupling Level at Product Frequency (dB)	External Attenuator (dB)	Cable Loss (dB)	Notch or Band Pass Attenuation at Product Frequency (dB)	IM Level Displayed, 1 kHz RBW (dBm) [Note 1]	Adjusted Reading (dBm)	Carrier Reference Level (dBm)	Level Referenced to Carrier (dB)	73.317(d) Requirement (dB)	Level Relative to Requirement (dB)
92.9	106.3	**79.5**	-60.54	0	-0.63	-0.36	-95.03	-33.50	71.4	**-104.9**	80.0	**-24.9**
92.9	102.3	**83.5**	-60.54	0	-0.64	-0.44	-98.75	-37.13	71.4	**-108.5**	80.0	**-28.5**
102.3	106.3	**98.3**	-60.54	10	-0.70	-1.30	-112.29	-39.75	71.8	**-111.5**	80.0	**-31.5**
106.3	102.3	**110.3**	-60.54	0	-0.74	-0.44	-114.20	-52.48	69.7	**-122.1**	80.0	**-42.1**
102.3	92.9	**111.7**	-60.54	0	-0.74	-0.39	-114.33	-52.66	71.8	**-124.4**	80.0	**-44.4**
106.3	92.9	**119.7**	-60.54	0	-0.77	-0.37	-114.31	-52.63	69.7	**-122.3**	80.0	**-42.3**
92.9	96.3	**89.5**	-60.54	0	-0.66	-1.22	-88.88	-26.45	71.4	**-97.8**	80.0	**-17.8**
92.9	93.5	**92.3**	-60.54	0	-0.68	-9.66	-102.53	-31.66	71.4	**-103.0**	80.0	**-23.0**
92.9	92.5	**93.3**	-60.54	10	-0.68	-12.10	-108.14	-24.82	71.4	**-96.2**	80.0	**-16.2**
92.9	88.3	**97.5**	-60.54	10	-0.69	-1.23	-92.37	-19.90	71.4	**-91.3**	80.0	**-11.3**
102.3	103.9	**100.7**	-60.54	10	-0.70	-3.48	-111.90	-37.17	71.8	**-109.0**	80.0	**-29.0**
102.3	102.9	**101.7**	-60.54	10	-0.71	-9.56	-106.06	-25.26	71.8	**-97.0**	80.0	**-17.0**
102.3	100.9	**103.7**	-60.54	10	-0.72	-6.11	-109.85	-32.48	71.8	**-104.3**	80.0	**-24.3**
102.3	100.5	**104.1**	-60.54	10	-0.72	-5.13	-109.84	-33.46	71.8	**-105.2**	80.0	**-25.2**
102.3	99.9	**104.7**	-60.54	10	-0.72	-4.83	-89.20	-13.12	71.8	**-84.9**	80.0	**-4.9**
102.3	**99.9**	**104.7**	**-60.54**	**20**	**-0.72**	**-4.83**	**-100.60**	**-14.52**	**71.8**	**-86.3**	**80.0**	**-6.3 [Note 2]**
106.3	103.9	**108.7**	-60.54	20	-0.73	-0.73	-114.03	-32.03	69.7	**-101.7**	80.0	**-21.7**
106.3	102.9	**109.7**	-60.54	20	-0.73	-0.50	-114.46	-32.69	69.7	**-102.3**	80.0	**-22.3**

NOTES: 1) In many cases, the measured signal was at the noise floor of the spectrum analyzer. All measurements were adequate to show that each potential product level is lower than the limit, but the actual level may in general be even lower than the level recorded here.

2) Repeated measurement of 104.7 MHz after increasing the external pad from 10 dB to 20 dB and recorded a similar result. This possible emission meets requirements in both measurements cases.

Table 6 - Harmonic Measurements – KNIN / KWFS / KBZS Combined System

Carrier Frequency (MHz)	Harmonic #	Harmonic Frequency (MHz)	Directional Coupler Coupling Level at Product Frequency (dB) [Note 2]	External Attenuator (dB)	Cable Loss (dB)	Double High Pass Filter Loss (dB)	Level Displayed, 1 kHz RBW (dBm) [Note 1]	Adjusted Reading (dBm)	Carrier Reference Level (dBm)	Level Referenced to Carrier (dB)	73.317(d) Requirement (dB)	Level Relative to Requirement (dB)
92.9	2	**185.8**	-60.5	0	-0.97	-0.68	-115.07	-52.88	71.4	**-124.3**	71.4	**-52.9**
102.3	2	**204.6**	-60.5	0	-1.02	-0.53	-114.77	-52.68	71.8	**-124.5**	71.8	**-52.7**
106.3	2	**212.6**	-60.5	0	-1.04	-0.50	-102.53	-40.46	69.7	**-110.1**	69.7	**-40.5**
92.9	3	**278.7**	-60.5	0	-1.19	-0.40	-113.61	-51.47	71.4	**-122.9**	71.4	**-51.5**
102.3	3	**306.9**	-60.5	0	-1.25	-0.39	-114.73	-52.55	71.8	**-124.3**	71.8	**-52.6**
106.3	3	**318.9**	-60.5	0	-1.28	-0.36	-110.84	-48.67	69.7	**-118.3**	69.7	**-48.7**
92.9	4	**371.6**	-60.5	0	-1.38	-0.42	-115.05	-52.72	71.4	**-124.1**	71.4	**-52.7**
102.3	4	**409.2**	-60.5	0	-1.45	-0.44	-115.34	-52.90	71.8	**-124.7**	71.8	**-52.9**
106.3	4	**425.2**	-60.5	0	-1.48	-0.56	-115.20	-52.63	69.7	**-122.3**	69.7	**-52.6**
92.9	5	**464.5**	-60.5	0	-1.55	-0.57	-115.13	-52.47	71.4	**-123.9**	71.4	**-52.5**
102.3	5	**511.5**	-60.5	0	-1.63	-0.58	-113.95	-51.21	71.8	**-123.0**	71.8	**-51.2**
106.3	5	**531.5**	-60.5	0	-1.66	-0.51	-114.37	-51.66	69.7	**-121.3**	69.7	**-51.7**
92.9	6	**557.4**	-60.5	0	-1.70	-0.50	-113.08	-50.34	71.4	**-121.7**	71.4	**-50.3**
102.3	6	**613.8**	-60.5	0	-1.79	-0.45	-114.6	-51.82	71.8	**-123.6**	71.8	**-51.8**
106.3	6	**637.8**	-60.5	0	-1.82	-0.44	-114.2	-51.39	69.7	**-121.0**	69.7	**-51.4**
92.9	7	**650.3**	-60.5	0	-1.84	-0.41	-114.20	-51.40	71.4	**-122.8**	71.4	**-51.4**
102.3	7	**716.1**	-60.5	0	-1.93	-0.41	-115.60	-52.72	71.8	**-124.5**	71.8	**-52.7**
92.9	8	**743.2**	-60.5	0	-1.97	-0.43	-115.50	-52.56	71.4	**-123.9**	71.4	**-52.6**
106.3	7	**744.1**	-60.5	0	-1.98	-0.43	-114.70	-51.76	69.7	**-121.4**	69.7	**-51.8**
102.3	8	**818.4**	-60.5	0	-2.05	-0.43	-114.62	-51.60	71.8	**-123.4**	71.8	**-51.6**
92.9	9	**836.1**	-60.5	0	-2.05	-0.45	-114.00	-50.96	71.4	**-122.3**	71.4	**-51.0**
106.3	8	**850.4**	-60.5	0	-2.05	-0.44	-114.80	-51.77	69.7	**-121.4**	69.7	**-51.8**
102.3	9	**920.7**	-60.5	0	-2.05	-0.46	-115.00	-51.95	71.8	**-123.7**	71.8	**-51.9**
92.9	10	**929.0**	-60.5	0	-2.05	-0.46	-114.00	-50.95	71.4	**-122.3**	71.4	**-51.0**
106.3	9	**956.7**	-60.5	0	-2.05	-0.47	-113.50	-50.44	69.7	**-120.1**	69.7	**-50.4**
92.9	11	**1021.9**	-60.5	0	-2.05	-0.47	-113.00	-49.94	71.4	**-121.3**	71.4	**-49.9**
102.3	10	**1023.0**	-60.5	0	-2.05	-0.47	-113.70	-50.64	71.8	**-122.4**	71.8	**-50.6**
106.3	10	**1063.0**	-60.5	0	-2.05	-0.48	-114.00	-50.93	69.7	**-120.6**	69.7	**-50.9**
102.3	11	**1125.3**	-60.5	0	-2.05	-0.49	-114.00	-50.92	71.8	**-122.7**	71.8	**-50.9**
106.3	11	**1169.3**	-60.5	0	-2.05	-0.54	-114.00	-50.88	69.7	**-120.5**	69.7	**-50.9**

NOTES: 1) In many cases, the measured signal was at the noise floor of the spectrum analyzer. All measurements were adequate to show that each potential product level is lower than the limit, but the actual level may in general be even lower than the level recorded here.

2) The coupling level at 98 MHz was used here. The broad coupling characteristics of the coupler in this system were not available. The design of the ERI directional couplers exhibits higher coupling (less negative) as the frequency increases, so corrected readings shown here are conservative and may be overstated by up to 15 dB at 800 MHz based on typical measured data from a similar coupler.

4 Occupied Bandwidth / Mask Measurements

Additional measurements of compliance were made to show compliance with 73.317(b) through (d) in the 2 MHz band near the carrier frequency. These occupied bandwidth / mask measurements are presented herein.

In Figure 5, Figure 6 and Figure 7, verification of compliance with the occupied bandwidth and mask requirements of 73.317(b) through (d) are shown. These measurements were collected using the Anritsu S332E spectrum analyzer. Both 300 kHz resolution bandwidth and 1 kHz resolution bandwidth data are shown on the same plot along with the FCC 73.317 mask, where all data is normalized to the peak of the 300 kHz RBW plot.

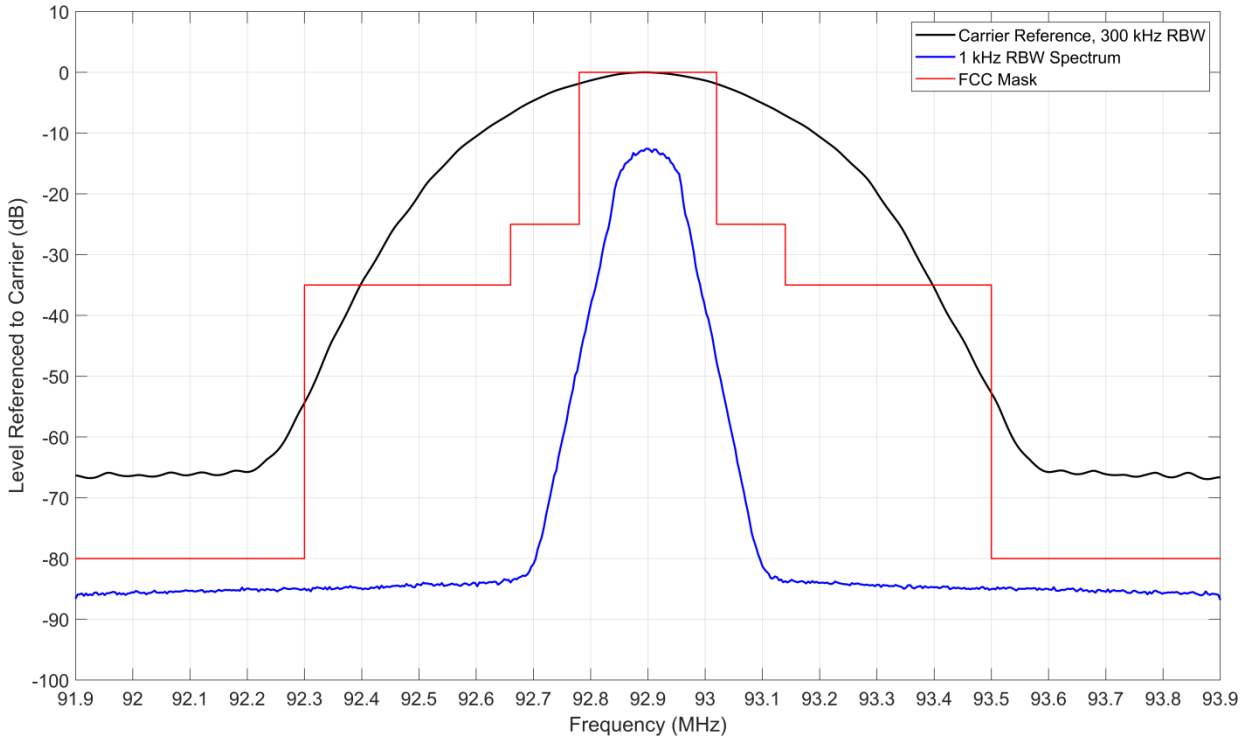

Figure 5 – KNIN-FM 92.9 MHz, 73.317(b) through (d) Mask Compliance

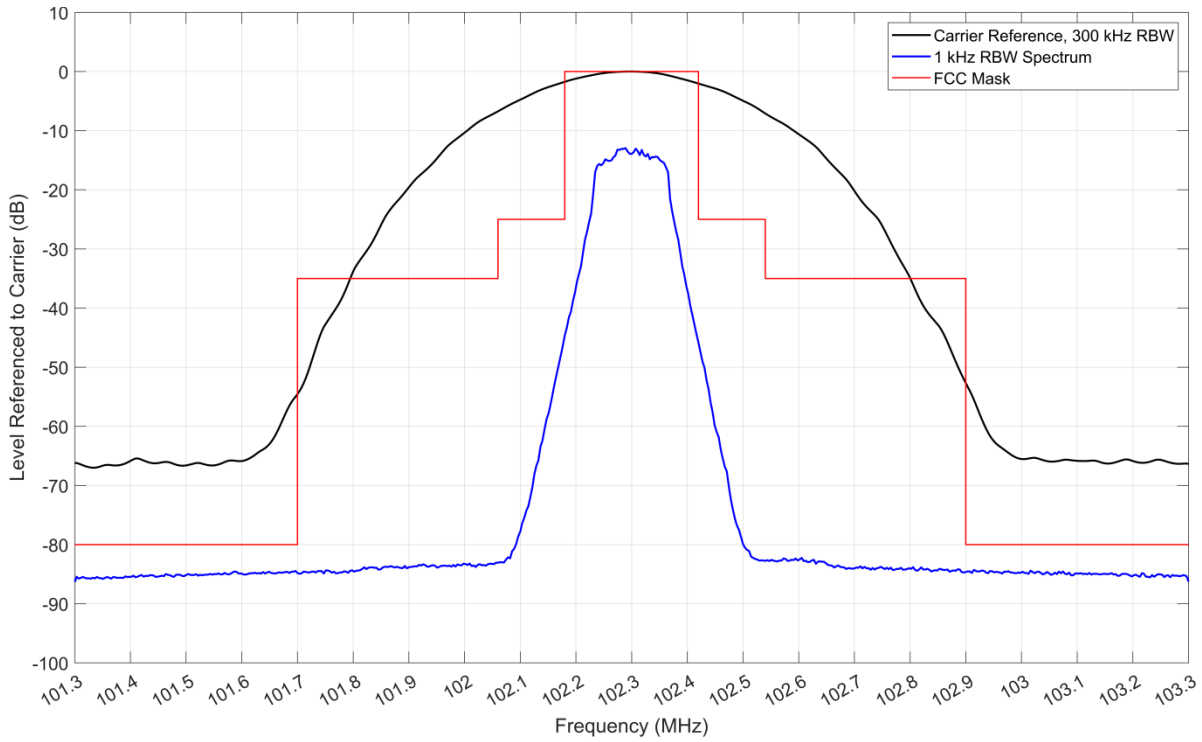

Figure 6 – KWFS-FM 102.3 MHz, 73.317(b) through (d) Mask Compliance

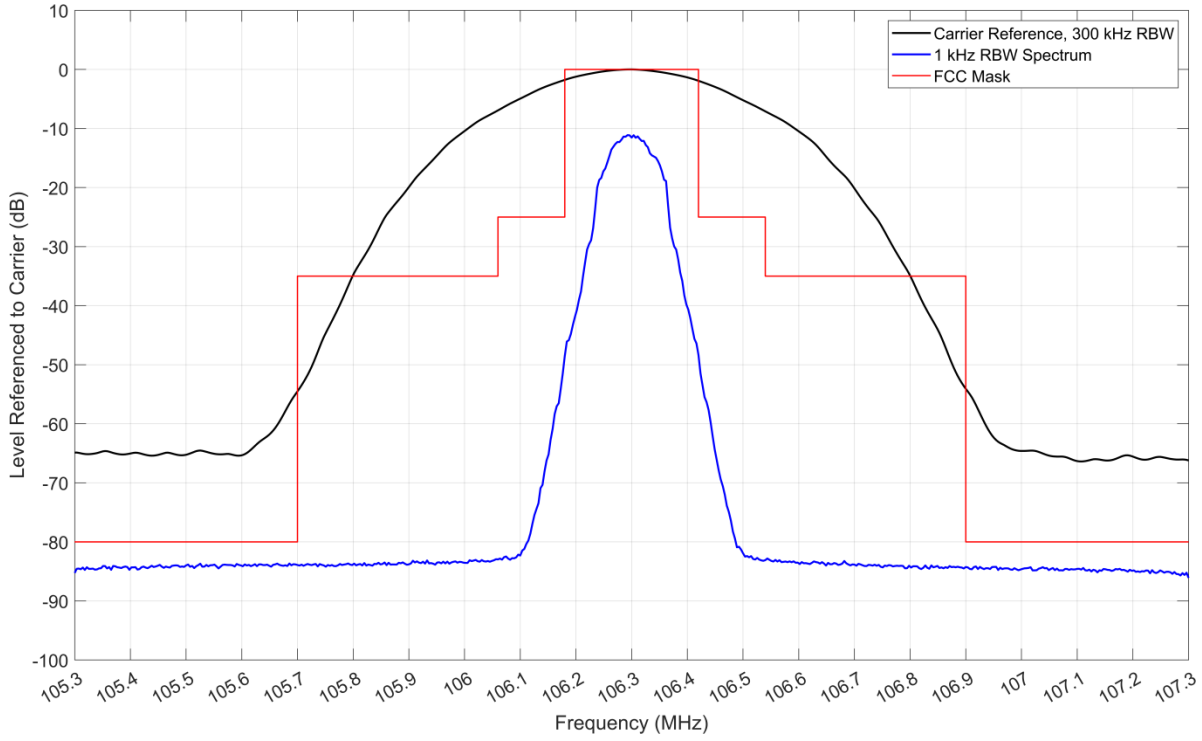

Figure 7 – KBZS-FM 106.3 MHz, 73.317(b) through (d) Mask Compliance

5 Conclusions

Based upon the observations and measurements recorded in this document, I, Eric R. Wandel, find the operation of the combined FM system for stations:

- KNIN-FM 225C1 / 92.9 MHz, Wichita Falls, TX / FID 43754
- KWFS-FM 272C1 / 102.3 MHz, Wichita Falls, TX / FID 1722
- KBZS-FM 292C2 / 106.3 MHz, Wichita Falls, TX / FID 52074

as described herein and located at tower ASRN 1052224 in Wichita Falls, Texas, to be in compliance with the requirements of CFR Title 47, Section 73.317(b) through (d).

Respectfully submitted by Eric R. Wandel, P.E.

AFFIDAVIT

I, Eric R. Wandel, employed by Wavepoint Research, Inc. and under the commission of Townsquare Media, have performed the preparation of all technical information contained in this document and to my knowledge have made no misrepresentations or false claims.

1. Education includes:
   a) The degree of Bachelor of Science in Electrical Engineering from Rose-Hulman Institute of Technology, Terre Haute, Indiana
   b) The degree of Bachelor of Science in Applied Optics from Rose-Hulman Institute of Technology, Terre Haute, Indiana
   c) The degree of Master of Science in Electrical Engineering from Rensselaer Polytechnic Institute, Troy, New York
2. Experience includes:
   a) 32 years of experience in systems engineering work related to RF engineering, signal processing, antenna and filter design, including design, installation and field checkout of high power broadcast systems.
3. Licensed Professional Engineer
   a) State of Tennessee, Registration Number: 126598

Eric R Wandel

Eric R. Wandel, P.E.

February 14, 2024
Date

Exhibit A – Citation from CFR Title 47, Sections 73.317

Code of Federal Regulations

TITLE 47 - TELECOMMUNICATION
CHAPTER I - FEDERAL COMMUNICATIONS COMMISSION
SUBCHAPTER C - BROADCAST RADIO SERVICES
PART 73 - RADIO BROADCAST SERVICES
Subpart B - FM Broadcast Stations

§ 73.317 FM transmission system requirements.

a) FM broadcast stations employing transmitters authorized after January 1, 1960, must maintain the bandwidth occupied by their emissions in accordance with the specification detailed below. FM broadcast stations employing transmitters installed or type accepted before January 1, 1960, must achieve the highest degree of compliance with these specifications practicable with their existing equipment. In either case, should harmful interference to other authorized stations occur, the licensee shall correct the problem promptly or cease operation.

b) Any emission appearing on a frequency removed from the carrier by between 120 kHz and 240 kHz inclusive must be attenuated at least 25 dB below the level of the unmodulated carrier. Compliance with this requirement will be deemed to show the occupied bandwidth to be 240 kHz or less.

c) Any emission appearing on a frequency removed from the carrier by more than 240 kHz and up to and including 600 kHz must be attenuated at least 35 dB below the level of the unmodulated carrier.

d) Any emission appearing on a frequency removed from the carrier by more than 600 kHz must be attenuated at least $43 + 10 \text{ Log}_{10}$ (Power, in watts) dB below the level of the unmodulated carrier, or 80 dB, whichever is the lesser attenuation.

e) Preemphasis shall not be greater than the impedance-frequency characteristics of a series inductance resistance network having a time constant of 75 microseconds. (See upper curve of Figure 2 of § 73.333.)

Exhibit B – TPO Calculations

	Wichita Falls, TX	*Wichita Falls, TX*	*Wichita Falls, TX*
Station Call Sign	**KNIN-FM**	**KWFS-FM**	**KBZS-FM**
Frequency (MHz)	**92.9**	**102.3**	**106.3**
	Analog only	**Analog only**	**Analog only**
ERP (W)	**100000**	**100000**	**50000**
Antenna Model	ERI SHPB-12C6-SP	ERI SHPB-12C6-SP	ERI SHPB-12C6-SP
Antenna Gain, peak of beam (multiplier)	5.8210	6.5460	5.5160
Antenna input power (W)	**17179**	**15277**	**9065**
Upper Transmission Line	ERI 4-1/16" Rigid	ERI 4-1/16" Rigid	ERI 4-1/16" Rigid
Line Length (feet)	361	361	361
Line loss per hundred feet (dB/100')	0.072	0.075	0.077
Vertical Line loss total (dB)	0.2599	0.2708	0.2780
Power Into Rigid Transmission Line (W)	**18239**	**16259**	**9664**
Filter Insertion Loss (dB)	0.2	0.2	0.2
TPO (kW) *rounded per 47CFR73.212*	**19.0**	**17.0**	**10.1**