# REPORT OF FINDINGS
# 11 STATION COMBINED AUXILIARY BROADCAST FACILITY
# MIAMI, FLORIDA

This report has been prepared specifically for FM radio station WEDR. The station operates at a frequency of 99.1 Megahertz in the Miami, Florida metro area from the American Tower broadcast tower and facility.

## Introduction

WEDR has rearranged their operations to now include the ability to switch from their Main FM antenna (an SHP-10AC-HW-SP, 10 section side mount antenna) to a side mounted auxiliary Axiom Master FM Antenna owned and operated by American Tower. The radio station refers to their broadcast functioning as either **Normal Mode** while using their customary side mount antenna or **Emergency Mode** when using the Axiom Auxiliary Master FM Antenna.

The report presents findings from an investigation into intermodulation emissions associated with the operation of WEDR's transmitter while simultaneously broadcasting along with a group of other stations that share the common Axiom Master FM antenna. In the **Emergency Mode,** all stations operated with a transmitter output power of 10 Kilowatts. Table 1 lists the group of FM radio stations that normally use the Combiner and Master FM as their primary Auxiliary broadcast means. In brief, the collection of information presented in this report shows that all combined possible third order intermodulation (IM) products generated by this multiplex system (while WEDR operates) are less than the maximum allowable level as required by section 73.317 (b) through (d). Robert Rose of Electronics Research, Inc. located in Chandler, Indiana performed the measurements summarized herein on December 9, 2006.

Referring to drawing No. A-3, note the two positions of the Patch Panel labeled S1: it is from this Patch Panel that WEDR's transmitter is configured for one of the two modes of operation. In the Emergency Mode, the RF energy from the transmitter is injected through the ERI filter into the rear of the Shively Laboratories (10 module) Combiner, whereas, in the Normal Mode the energy is directed to the side mounted antenna located some distance above the Axiom Master Antenna. In either case, WEDR's transmitter is isolated from other transmitter interference via the ERI filter, model No. 963-8 (Product Eliminator).

## Exhibits Accompanying Report

Exhibits A-1 and A-2 provide comprehensive information on the antenna and specifications used by these radio stations. Exhibit A-3 illustrates the combining scheme of the stations and Exhibit B illustrates the layout of the equipment used to isolate and measure potential intermodulation products and forward carrier reference levels. Found within Table 1 are the station carrier frequencies that provide the interfering frequencies for the IM analysis. Tables 2 and 3 are the predictable third-order products calculated from Table 1. Table 2 lists the calculated third order product frequencies that can be generated from the WEDR FM transmitter while broadcasting from the multiplexed system and the station mixing, listed in Table 3, provides additional product frequencies that were investigated that could be generated in all other transmitters.

## The following exhibits are provided:

Exhibit A:

A-1 Drawing Depicting Antenna.

A-2 SHPX-16AC6-HW-SP ***Axiom*** Antenna Specification Sheet.

A-3 Drawing Depicting Multiplexing Scheme.

Exhibit B:

B-1 Equipment Employed In Intermodulation Product Measurement.

Table 1. Station Group (List of normal users of the Auxiliary Axiom Antenna)

Table 2. Calculated Third Order Products: WEDR Transmitter Interference

Table 3. Calculated Third Order Products: Station Group Transmitter Interference

## The Nature of Intermodulation Products (IM)

Intermodulation products result from inadequate transmitter-to-transmitter isolation and are commonly generated from radio stations operating into multiplexed facilities and congested antenna broadcast sites. The mechanics associated with the phenomenon are 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 this phenomenon is 'third order product' denoted by the mathematical expression [ $2(F_1)-(F_2)$ ], where $F_1$ signifies the frequency of the transmitter that is generating the intermodulation product, and $F_2$ signifying the frequency causing the interference.

## The Multiplexed System

At the time of my measurements, eleven FM stations were operating from the combined antenna system. The WHDR, WLVE, WMGE, WPOW, WFLC, WHYI, WMXJ, WMIB, WHQT, WAMR and WEDR multiplexed system is fundamentally comprised of antenna, feed line and multiplexer units. The SHPX-16AC6-HW-SP (Axiom) antenna is a product of ***Electronics Research, Inc.***; whereas, the feed line is manufactured by ***Dielectric, Inc***. To accomplish the aggregation of eleven transmitter signals into the common antenna feed system and provide transmitter-to-transmitter isolation, a multiplexing scheme consisting of 10 ***Shively Laboratories*** Constant Impedance Combiner modules is used. WEDR uses a filtering device similar to a Constant Impedance Combiner manufactured by ***Electronics Research, Inc***. See attached Exhibit A-3 for an illustration of the combiner layout.

## The IM Investigation

To facilitate in the taking of the measurements, a coupler located at the antenna output of the multiplexed system was used. The coupler is a clamp-on type ERI Directional Coupler designed to be placed in the 9" transmission line at the combiner output. The coupler was factory calibrated and capable of delivering accurate and repeatable RF measurements. Care was taken in the selection of the measurement location to insure that the measurements would be made far removed from transmitters and any filtering used to reduce broadcast emissions. The coupler's normal use is for antenna reflection measurements and thus would provide greater than -35 dB directivity and a forward signal sample of -42 dB. Exhibit A-3 also shows the location of this coupler.

The forward port of the coupler was used for sampling the outgoing level of WEDR's carrier and all IM products investigated. The IM sampled signal was fed by shielded cable into a Band Pass Filter where all extraneous energy was steeply attenuated. Various attenuation pads were used, when needed, on the band pass filter and/or the FIM71 to insure an adequate signal level for measurements without overloading the measurement equipment. A Potomac Instruments FIM-71 Field Strength Receiver was employed to record the level of all signals investigated. To facilitate the selective tuning of the Receiver and Band Pass Filter, the tracking signal generator function of an IFR Model 2399 Spectrum Analyzer was used. The Spectrum Analyzer was also used to measure the close-in spectral attenuation of WEDR's carrier and facilitate a means to provide a wide band search for any anomalies that may need further investigation. See attached Exhibit B-1 for an illustration of the measurement equipment.

Prior to recording measurements, all transmitters were adjusted and confirmed to operate at a reduced power level of 10 Kilowatts. This level was imposed to insure that the auxiliary antenna power rating is not exceeded. To make certain that the spurious emission performance is as measured and reported on in this report, this power level should not be exceeded while WEDR operates from the Auxiliary system.

From the equipment setup described in Figure B-1, the output signal level of WEDR station's forward carrier was measured. This level was used as the reference level for IM products possibly present from any transmitter operating from the multiplexed system. The final IM emission measurements, referenced to WEDR's forward carrier, are recorded in the column labeled IM level in Table 2 & 3.

As a final proof of the system's IM Product performance, a wideband search was undertaken using the Spectrum Analyzer. The purpose for this measurement was to look for suspicious anomalies that may warrant further investigation. My search ranged the complete frequency span of the receiver and resulted in no additional anomalies and subsequently no further investigations.

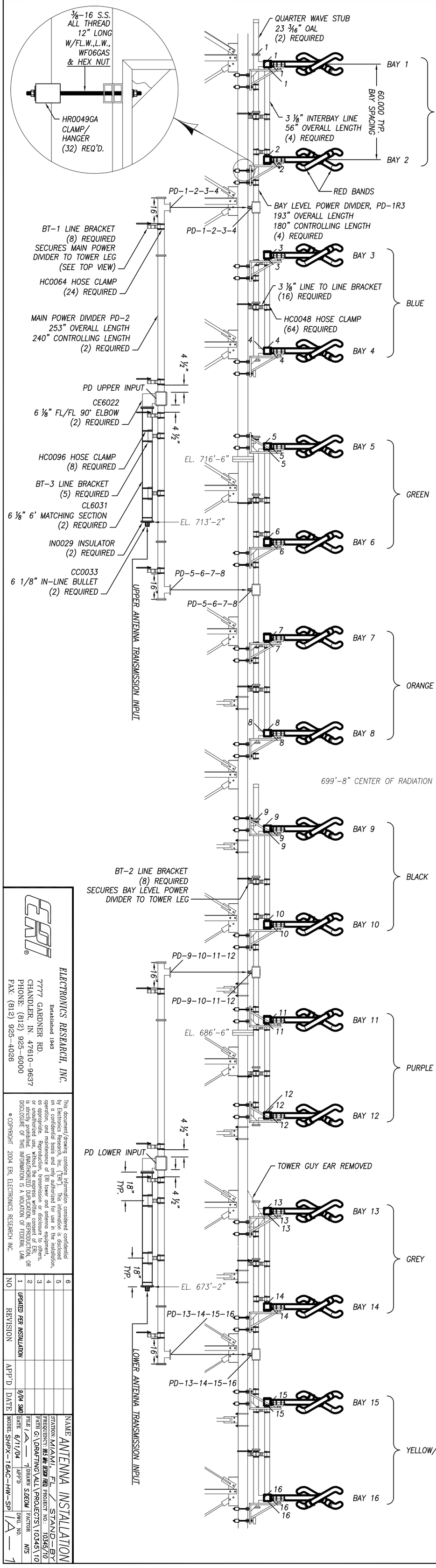
The Spectrum Analyzer was also used to check the close-in spectral attenuation of WEDR's carrier to confirm the operation of their transmitter being in compliance with Sections (b) and (c) of the FCC Rules and Regulations.

**Conclusion**

Based upon my observations and measurements taken December 9, 2006 as summarized in this document, I, Robert Rose, find the subject multiplexed system and specifically the transmitters and combiner system for the operation of the WHDR, WLVE, WMGE, WPOW, WFLC, WHYI, WMXJ WMIB, WHQT WAMR and WEDR into the SHPX-16AC6-HW-SP Axiom Antenna to be in proper working order. Furthermore, based on the measured data, it is my opinion that there are no intermodulation products in excess of 80 dB below WEDR's carrier level generated from the stations operating on the system in emergency mode. Also, based on this recorded data, I conclude that WEDR is in compliance with the requirements of Section 73.317 paragraph (b) through (d) of the FCC Rules and Regulations.

Respectfully submitted,
Electronics Research, Inc.

Robert Rose
V.P., FM Engineering




# EXHIBIT A-1

NOTES:

1) ALL RED BANDS DESIGNATE SIDE TO BE MOUNTED DOWNWARD.

2) COLOR LABELING IS FOR QUICK VISUAL PLACEMENT. ACTUAL ASSEMBLY OF ANTENNA SYSTEM SHOULD FOLLOW MATING CORRESPONDING NUMBERS & LETTERS.

3) ALL 3 1/8" LINE BLOCK CONNECTIONS REQUIRE 3/8"–16 X 7/8" LONG HEX BOLT W/ LOCKWASHER & OR2340S O–RING & GREASE.
ALL 3 1/8" LINE FLANGE CONNECTIONS REQUIRE 3/8"–16 X 1 1/2" LONG HEX BOLT W/ LOCKWASHER & HEX NUT, OR2340S O–RING & GREASE.
ALL 4 1/16" POWER DIVIDER BLOCK CONNECTIONS REQUIRE 3/8"–16 X 1" LONG HEX BOLT W/ LOCKWASHER & OR2348S O–RING & GREASE.
ALL 4 1/16" LINE FLANGE CONNECTIONS REQUIRE 3/8"–16 X 1 1/2" LONG HEX BOLT W/ LOCKWASHER & HEX NUT, OR2348S O–RING & GREASE.
ALL 6 1/8" POWER DIVIDER BLOCK CONNECTIONS REQUIRE 3/8"–16 X 1 1/4" LONG HEX BOLT W/ LOCKWASHER & OR2438S O–RING & GREASE.
ALL 6 1/8" LINE FLANGE CONNECTIONS REQUIRE 3/8"–16 X 1 3/4" HEX BOLT W/ LOCKWASHER & HEX NUT, OR2438S O–RING & GREASE.

4) OVERALL LENGTH OF ANTENNA SYSTEM IS 76'–0" APPROXIMATELY.

5) ENSURE TO PLUMB ANTENNA VERTICALLY BY LOOSENING HOSE CLAMPS ON PRE–CLAMPED SUPPORT SADDLES AND ADJUSTABLE LINE BRACKETS.

6) ROTATE CENTERFEED ASSEMBLY AS CLOSE TO TOWER AS POSSIBLE.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Established 1943
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| NO | REVISION | APP'D | DATE |
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| 6 | | | |
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| 1 | UPDATED PER INSTALLATION | | 9/04 SMD |

NAME: ANTENNA INSTALLATION
STATION: MIAMI, FL / STAND–BY
FREQUENCY: 93.1 MHz (CCW FED) PROJECT NO.: 10345/10
PATH G:\DRAFTING\ALL PROJECTS\10345\10
FILE: 1A — 7 DRAWN: S.DEOM
DATE: 6/11/04 APP'D:
MODEL: SHPX–16AC–HW–SP DWG. NO.: 1A — 7
FACTOR: NTS

# Miami, Florida

## Issue #2: December 21, 2004

**ERI Auxiliary Antenna Specification Summary**
**This project is exemplified in drawing No. E-1 Dated July 26, 2004**

## *General Specifications*

Antenna Type..... High Power FM-Broadcast, Suitable For Multi-Station Operation
Model Number..... SHPX-16AC-HW-SP (Side Mount)
Number Of Elements Comprising Design..... Sixteen, arranged As Follows:
A) Two (Independent) Eight Bay Arrays Placed On East Support Tower Leg.
B) The Arrangement
Input Feed Arrangement..... Each Antenna Half Fed Independently From Dual Feed
Broadcasting Mode.....Right Hand Circular Polarized
Station Capacity (Approximated)..... Ten, Class FM Broadcast Channels

## *Electrical Specifications*

Input Power Capability (Dual Feed)..... 136 KW Maximum (68 KW, Each Antenna Half) (1)
Operating Band-Width..... 93 - 108 Megahertz (15 MHz. Band)
VSWR (Each Half).....Less Than 1.15:1 @ Operating Frequencies (2)
VSWR (System)..... Less Than 1.25:1 @ Operating Frequencies (2)
Typical Azimuthal Pattern Circularity.....Less Than +/- 2 db From RMS (Free Space) (3)
Elevation Pattern.....Null Fill 0 % & Beam Tilt 0.0 Degrees
Power Split.....50/50 (Horizontal & Vertical)
Axial Ratio..... Less Than 2 dB
Frequency Specific Information (Assumes 95% Antenna Efficiency):

**Combiner losses are estimated therefore, some values (Losses & TPO's) are likely to be changed once actual losses are known.**

| Station | Frequency | TPO (Normal) | Losses (5) | Power Gain | Reduced ERP |
|---|---|---|---|---|---|
| WTMI | 93.1 MHz | 17.48 kW | 0.847 dB | 4.688 | 67.43 kW |
| WLVE | 93.9 MHz | 17.59 kW | 0.898 dB | 4.732 | 67.69 kW |
| WZTA | 94.9 MHz | 17.39 kW | 0.799 dB | 4.787 | 69.26 kW |
| WPOW | 96.5 MHz | 17.19 kW | 1.051 dB | 4.871 | 65.73 kW |
| WFLC | 97.3 MHz | 16.11 kW | 0.752 dB | 4.911 | 66.54 kW |
| WHYI | 100.7 MHz | 15.38 kW | 0.956 dB | 5.070 | 62.57 kW |
| WMXJ | 102.7 MHz | 15.86 kW | 1.158 dB | 5.153 | 62.60 kW |
| WMGE | 103.5 MHz | 14.40 kW | 1.109 dB | 5.183 | 57.98 kW |
| WHQT | 105.1 MHz | 15.92 kW | 1.011 dB | 5.239 | 66.08 kW |
| WAMR* | 107.5 MHz | 13.74 kW | 1.214 dB | 5.310 | 55.18 kW |

* WAMR station is licensed to operate at 95 kW. The remaining 9 stations are licensed to operate at 100 kW.

## *Mechanical Specifications*

The Furnished Weight And Wind-Loading Information Is Provided Less Support Structure

Support Spine.....Preexisting 12'-0" Foot Face Triangular Tower
Calculated Antenna Area (Excluding Ice) ..... 92 $Ft^{2\,(4)}$
Weight (Excluding Ice).....2,200 Lbs
Antenna Harness ..... All Rigid Coax, ($3^{1}/_{8}$, Smallest Coaxial Material Used)
Antenna Center of Radiation .....699.67 Feet above Average Terrain
Input Connectors..... $6^{1}/_{8}$ Inch 50-Ohm EIA Flanged, Each Antenna Half
Array length .....76.0 Feet (Approx. Overall)
Bay Spacing ..... 60 Inch
Construction Material (Antenna) ..... All Non-Corrosive
Construction Material (Tower & Mounting) ..... Galvanized Plated Steel and Stainless Steel

1. **Average Power and Peak Voltage assume: Operating VSWR of 1.15:1; atmospheric pressure, dry air, no solar loading and multiple carriers; maximum (unobjectionable) transformer conductor temperature of 100°C (212°F). For a margin of safety (Average Power and Peak Voltage), it is suggested that the antenna operate below its rated power. Determination of level is at the consumer's discretion.**

**Note: for an increase of 1.09 times Average Power rating, pressurize the line with 5 lbs. nitrogen. The application of nitrogen pressurization increases rating to 75 kilowatts.**

2. **Operating Configurations and VSWR:**
   **The antenna system was built to operate in any one of three modes:**
   **Mode 1 & 2 involve operating from either the *Upper* or *Lower 8 bay* antenna halves.**
   **Mode 3 (normal mode): Both *Upper* and *Lower 8 bay*s are combined from within the facility's combiner room using a *Broadband Tee Splitter* and patching system.**
   **In planning for all contingencies, every effort was made to factory tune the antenna to the lowest possible VSWR. Consequently, the two antenna halves were optimized to be used separately or combined with the Tee Splitter.**
   **The final antenna VSWR (as installed) may vary slightly as a result of combining the upper and lower halves and may be affected by:**
   **A) The actual tower geometry and other tower paraphernalia (horizontal struts, diagonal bracing, antenna feeds, conduits, etc.) may interact with antenna bay elements. This interaction was considered when the antenna was factory tuned; however, tower model uncertainty is beyond the control of ERI.**

   **B) The bandwidth of the *2 Way Tee Splitter* and its placement is only critical if the transmission line system (composed of many elements) is not at optimal performance.**

   **C) A specification of 1.25:1 VSWR is believed to be a high estimate based on worst case conditions (accumulated mismatches of system components). The introduction of mismatches caused by Elbows and Anchor (Bullet) connections, Line Section Lengths, Patch Panels, Tee Splitter, Combiner Modules, etc. all contribute to the overall system VSWR.**

3. **Typical value is for both Vertical and Horizontal radiation components as based on computer simulation with full scale setup verification.**

4. **Values based on TIA\EIA/RS-222-F Standard.**

5. **Estimated using: A) Dual runs of 6 1/8" rigid line totaling 798 feet in length and B) Estimated -0.35 db combiner losses.**

# EXHIBIT A-2

Table 1. Station Group (List of normal users of the Auxiliary Axiom Antenna)

| | |
|---|---|
| WHDR | 93.1 |
| WLVE | 93.9 |
| WMGE | 94.9 |
| WPOW | 96.5 |
| WFLC | 97.3 |
| **WEDR** | **99.1** |
| WHYI | 100.7 |
| WMXJ | 102.7 |
| WMIB | 103.5 |
| WHQT | 105.1 |
| WAMR | 107.5 |

Table 2. Calculated Third Order Products: WEDR Transmitter Interference

| | | IM Level (dB) |
|---|---|---|
| WEDR & WHDR | 87.1 | -89 |
| WEDR & WLVE | 88.7 | -90.9 |
| WEDR & WMGE | 90.7 | -85.2 |
| WEDR & WPOW | 93.9 | CARRIER [1] |
| WEDR & WFLC | 95.5 | -82.1 |
| WEDR & WHYI | 102.3 | -81.1 & CARRIER [2 & 9] |
| WEDR & WMXJ | 106.3 | -92.4 |
| WEDR & WMIB | 107.9 | CARRIER [3] |
| WEDR & WHQT | 111.1 | -84.2 |
| WEDR & WAMR | 115.9 | -85.7 |

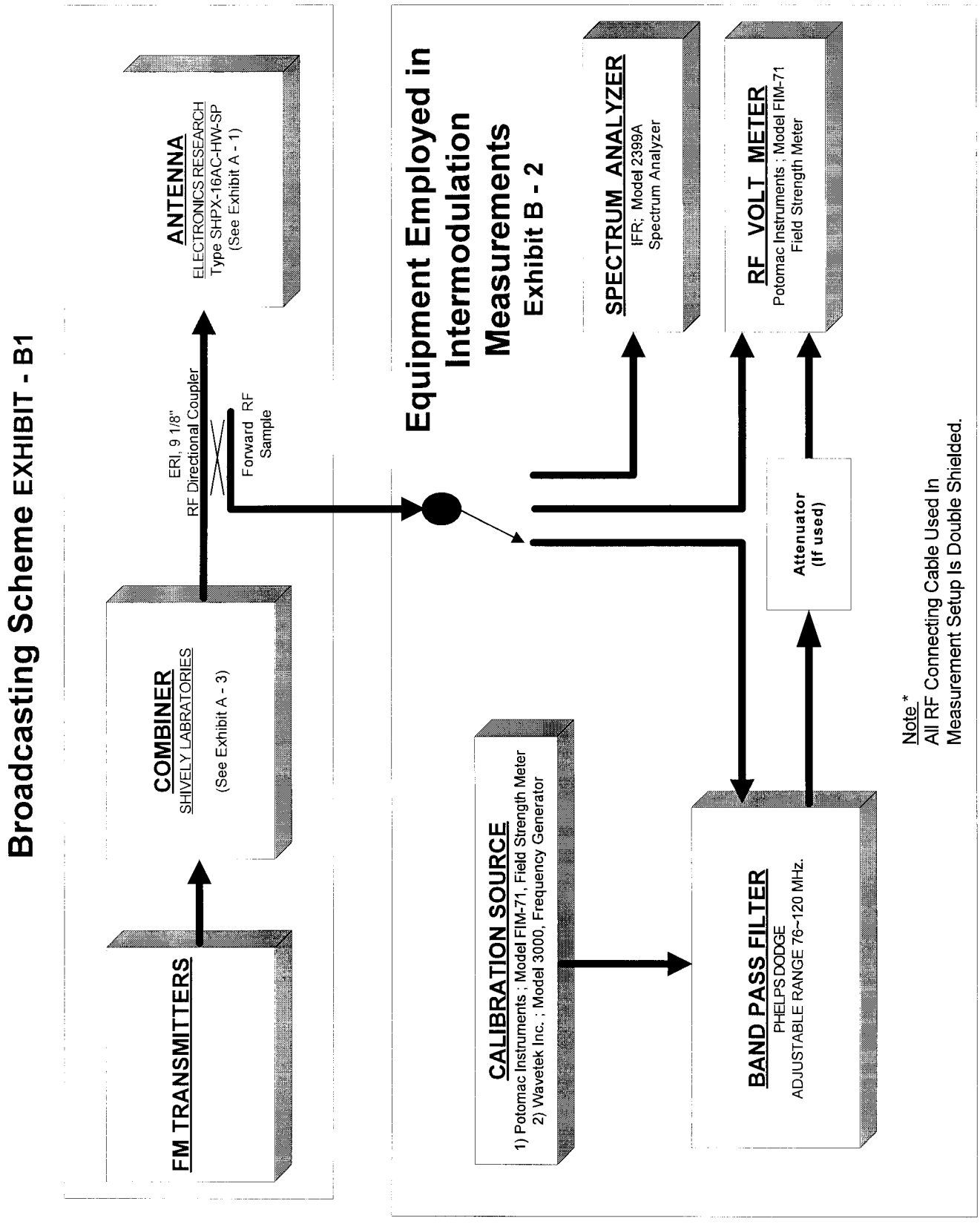
Table 3. Calculated Third Order Products: Station Group Transmitter Interference

| | | IM Level (dB) |
|---|---|---|
| WHDR & WEDR | 105.1 | CARRIER [4] |
| WLVE & WEDR | 104.3 | -82.1 |
| WMGE & WEDR | 103.3 | -84.3 & CARRIER [5 & 9] |
| WPOW & WEDR | 101.7 | -82.7 |
| WFLC & WEDR | 100.9 | -80.2 |
| WHYI & WEDR | 97.5 | CARRIER [6] |
| WMXJ & WEDR | 95.5 | -83.1 |
| WMIB & WEDR | 94.7 | CARRIER [7] |
| WHQT & WEDR | 93.1 | CARRIER [8] |
| WAMR & WEDR | 90.7 | -89.3 |

Notes:

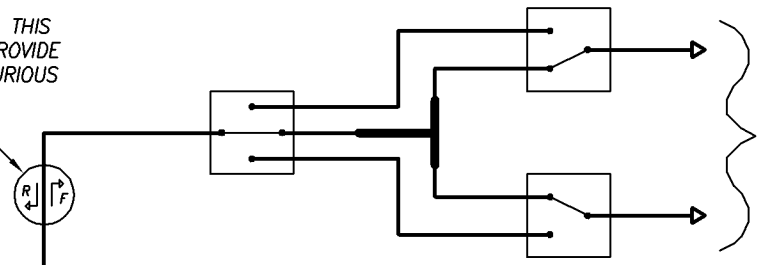
1. An overwhelming signal was detected which contributed to **WLVE** at the **93.9** MHz carrier.
2. An overwhelming signal was detected which contributed to **WMXJ** at the **102.7** MHz carrier.
3. An overwhelming signal was detected which contributed to **WAMR** at the **107.5** MHz carrier
4. An overwhelming signal was detected which contributed to **WHQT** at the **105.1** MHz carrier.
5. An overwhelming signal was detected which contributed to **WMIB** at the **103.5** MHz carrier.
6. An overwhelming signal was detected which contributed to **WFLC** at the **97.3 MHz** carrier.
7. An overwhelming signal was detected which contributed to **WMGE** at the **94.9 MHz** carrier.
8. An overwhelming signal was detected which contributed to **WHDR** at the **93.1 MHz** carrier.
9. A momentary carrier drop unmasked an admissible product level below -80 dB.

# Broadcasting Scheme and Equipment Employed in Intermodulation Measurements



THE SCHEMATIC SHOWS WEDR'S EMERGENCY MODE OF OPERATION FROM ATC SHIVELY STANDBY COMBINER & ERI ANTENNA, REFERRED TO AS THE AUXILIARY BROADCAST SYSTEM.

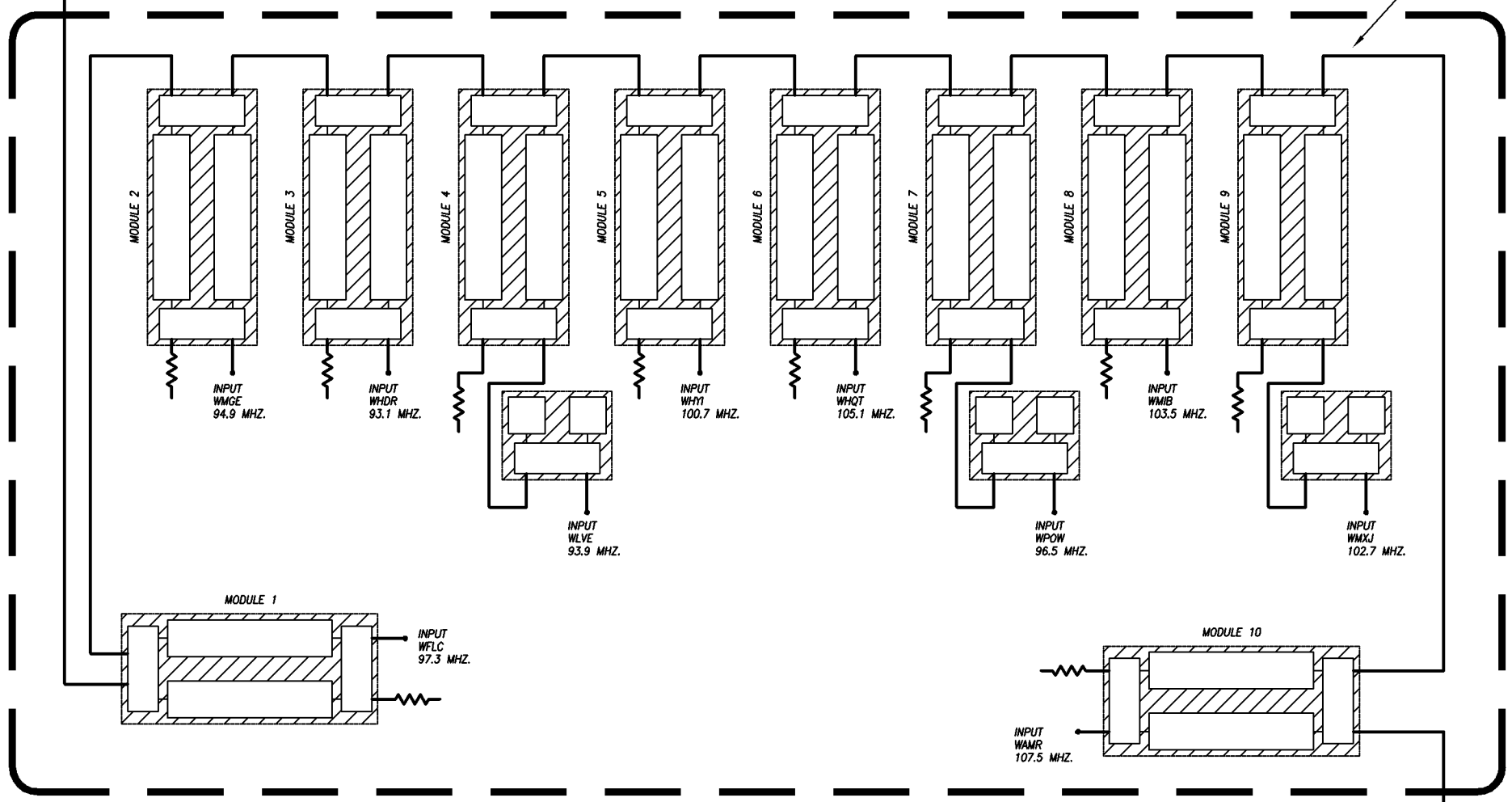
ERI DIRECTIONAL COUPLER. THIS COUPLER WAS USED TO PROVIDE RF SAMPLES FOR THE SPURIOUS EMISSION MEASUREMENTS.




FEEDS TO THE AUXILIARY ANTENNA. THE ANTENNA IS AN ELECTRONICS RESEARCH, INC. ERI SHPX-16AC-HW-SP AXIOM ANTENNA. THE INPUT POWER RATING OF THE DUAL FEED ANTENNA: 136 KW MAXIMUM (68 KW EACH ANTENNA HALF).

NOTE: THE UPPER AND LOWER HALVES OF THE ANTENNA ARE FED INDEPENDENTLY AND CAN BE PATCHED TO EITHER HALF FROM THIS PATCHING COMPLEX. IF THIS MODE OF OPERATION IS EVER USED, THE OPERATING POWER LEVEL OF ALL STATIONS MUST BE REDUCED FROM THE EMERGENCY OPERATING LEVEL OF 10 KW.

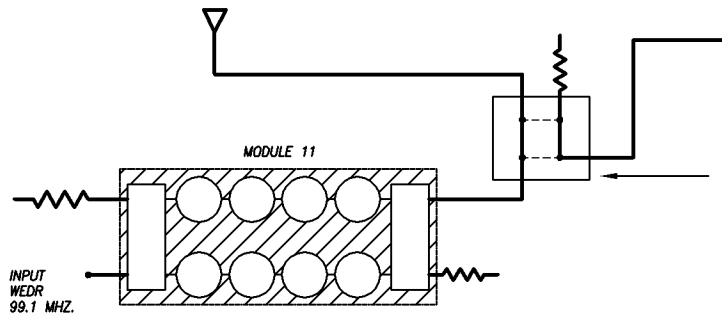
SHIVELY 10 STATION COMBINER (THE COMBINER IS COMPRISED OF 10 INDIVIDUAL MODULES THAT SHARE A COMMON LOCATION ON THE SECOND FLOOR OF THE FACILITY).




WARNING: ALL STATION TRANSMITTER POWER LEVELS MUST BE REDUCED TO 10 KW WHILE WEDR IS OPERATING INTO THE EMERGENCY PORT OF THE SHIVELY AUXILIARY COMBINER.

PLEASE BE ADVISED: A SPURIOUS EMISSION CHECK WAS PERFORMED WITH ALL STATIONS TRANSMITTERS OPERATING AT REDUCED POWER OF 10 KW. THIS LEVEL WAS IMPOSED TO INSURE THE AUXILIARY ANTENNA POWER RATING IS NOT EXCEEDED. TO MAKE CERTAIN THAT THE SPURIOUS EMISSION PERFORMANCE IS AS MEASURED (SEE REPORT) THIS POWER LEVEL SHOULD NOT BE EXCEEDED WHILE WEDR OPERATES FROM THE AUXILIARY SYSTEM.

WEDR MAIN ANTENNA (ERI-16AC-HW-SP)
16 SECTION SIDE MOUNT ANTENNA




963-6 (PRODUCT ELIMINATER)
INSTALLED IN WEDR TRANSMITTER ROOM, THE FILTER PROVIDES A VERY FREQUENCY SELECTIVE PASS-BAND TO WEDR'S TRANSMITTER.

PATCH PANEL (S1)
WEDR'S COAXIAL PATCHING INTO THE STANDBY COMBINER SYSTEM IS ACHIEVED BY REPOSITIONING THE U-LINKS OF THE PATCH PANEL.

EMERGENCY PATCH PANEL. THIS PATCHING DEVICE IS LOCATED IN WEDR'S TRANSMITTER ROOM.
NOTE: AS A SAFETY PRECAUTION, IT IS RECOMMENDED THAT ALL STATION TRANSMITTER INTERLOCKS ARE CONTROLLED FROM THIS DEVICE'S USE (I.E. IF THE U-LINK IS REMOVED ALL STATION TRANSMITTERS WILL SHUT OFF). THE DASHED LINES SHOW THE ALTERNATE POSITIONING OF THE U-LINKS.

# EXHIBIT A-3

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| NO | REVISION | APP'D | DATE |
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NAME MULTIPLEXING SCHEME
STATION: MIAMI, FL.
FREQUENCY: N/A PROJECT NO.: 07995
PATH
FILE A-3 DRAWN BAM FACTOR NTS
DATE 10/11/00 APP'D DWG. NO.
MODEL MULTIPLEXING SCHEME A-3