

# **Field Service Report FM Combiner and Antenna System**

**Cincinnati, OH.  
Broadcast Facility**

ERI Antenna: SHPX-4AC-SP  
ERI 963-3 "TEE" Combiner  
Feedline: Myat 3 1/8" 20' Sticks 177 Feet  
and Cablewave HCC-300-50J Flex 666 Feet  
WRRM – 98.5 MHz.  
WGRR – 103.5 MHz.

ERI Project # 33565

June 30, 2015

## **Submitted By:**

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**EXHIBIT B**  
**MODIFICATION OF STATION LICENSE**  
**RADIO LICENSE HOLDING SRC, LLC**  
**WRRM (FM) RADIO STATION**  
**CH 253B - 98.5 MHZ - 18.0 KW**  
**CINCINNATI, OHIO**  
**July 2015**



## **TABLE OF CONTENTS**

INTRODUCTION.....	3
SUMMARY and RECOMMENDATIONS .....	3
DRAWINGS .....	4
Figure 1: "T" Combiner Drawing for WRRM and WGRR.....	4
Figure 2: Antenna Drawing for WRRM and WGRR.....	5
Figure 3: Tuning Slug Location and Feedline Layout .....	6
Measurement 1: Match and Insertion Loss of 98.5 MHz. ....	7
Measurement 2: Isolation +/- 800 KHz. of 98.5 MHz.....	8
Measurement 3: Group Delay of 98.5 MHz. ....	9
Measurement 4: Match and Insertion Loss of 103.5 MHz. ....	10
Measurement 5: Isolation +/- 800 KHz. of 103.5 MHz.....	11
Measurement 6: Group Delay of 103.5 MHz. ....	12
Measurement 7: Port to Port Isolation 98.5 to 103.5 MHz.....	13
Measurement 8: Narrow Sweep of Feedline with 50 ohm Load.....	14
Measurement 9: 88 to 108 MHz. Sweep of Feedline with 50 ohm Load. ....	15
Measurement 10: 50 to 400 MHz. Sweep of Feedline with 50 ohm Load TDR. ....	16
Measurement 11: Narrow Sweep of Final Antenna 98.5 & 103.5 MHz. ....	17
Measurement 13: Final Antenna 98.5 MHz. Return Loss Measurement.....	18
Measurement 14: Final Antenna 103.5 MHz. Return Loss Measurement.....	19
Measurement 15: Filter to Antenna of 98.5 MHz. Return Loss Measurement.....	20
Measurement 16: Filter to Antenna of 103.5 MHz. Return Loss Measurement.....	21
Figure 4: Vertical Plane relative Field Plot of 98.5 MHz. ....	22
Figure 5: Vertical Plane Relative Field Plot of 103.5 MHz.....	23
Table 1: Loss Budget 98.5 MHz. ....	24
Table 2: Loss Budget Table 103.5 MHz. ....	25

## **INTRODUCTION**

Listed below is a summary of the data and attached are the plots collected from the WRRM ~ WGRR transmission site in Cincinnati, OH. By Jeff Taylor June 30, 2015.

- The antenna for WRRM and WGRR is a SHPX-4AC-SP.
- The combiner for WRRM and WGRR is a 963-3 "TEE" Combiner.
- Equipment used for the "T" combiner was a Rohde & Schwarz ZVL Network Analyzer.
- Equipment used for filter to antenna and antenna testing was a Rohde & Schwarz ZVL Network Analyzer High RF setup.
- All measurements of the "T" combiner for WRRM and WGRR were taken at the input of each directional coupler and at the output directional coupler.
- All feedline and antenna measurements were taken on the single port Bird sniffer unit after the Dielectric 3 1/8" switch.

**Site Address:** 1975 Radcliff Drive  
Cincinnati, OH.

**Attendees:** ERI Installations Service Technicians  
ERI: Jeff Taylor Field Technician  
Cumulus Engineer: Ron Gaier

The reason for this Field Service Trip was to sweep the feedline, tune antenna, fine adjust "T" combiner with retune of one bank from 94.5 MHz. to 103.5 MHz., and proof for the combined system WRRM and WGRR.

Final tuning of the WRRM and WGRR antenna was completed with VSWR's no worse than 1.07:1 @ carrier and 1.10:1 +/- 100 KHz. of carrier.

Filter to antenna performance for WRRM and WGRR VSWR's @ carriers was no worse than 1.10:1 and 1.17:1 +/- 100 KHz. of carrier.

The antenna was also tested to insure that the heaters were working for the combined system of WRRM & WGRR.

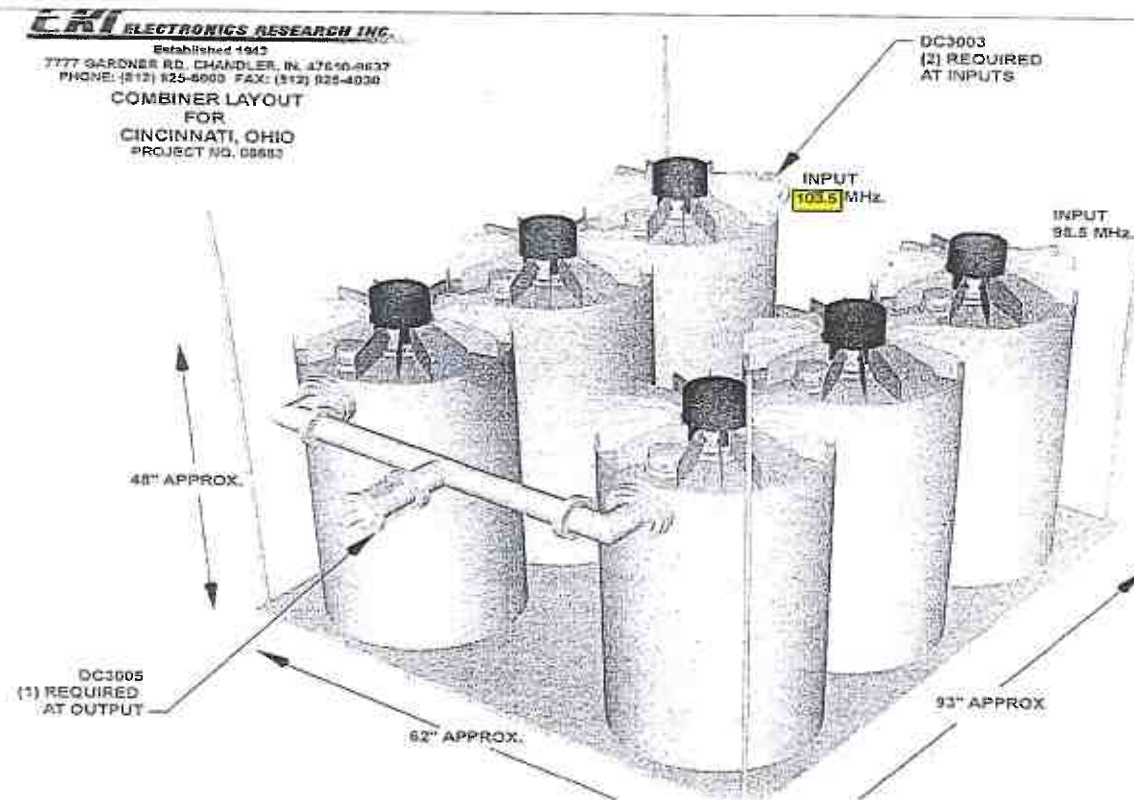
## **SUMMARY and RECOMMENDATIONS**

All measurements were taken by Jeff Taylor of Electronics Research Inc. June, 2015.

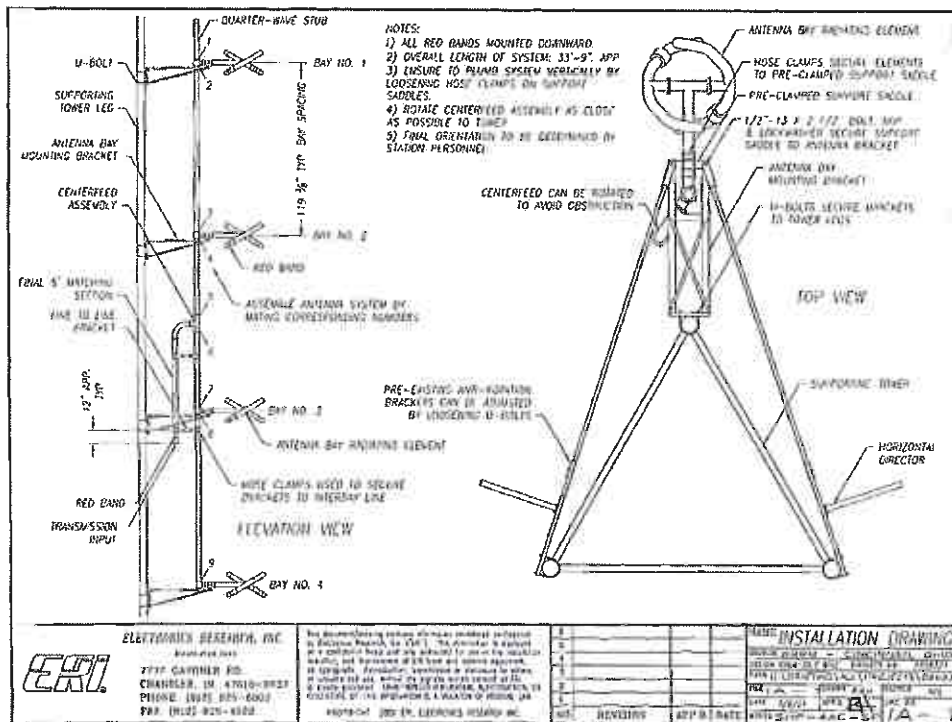
Sincerely Jeff Taylor

## DRAWINGS

Figure 1: "T" Combiner Drawing for WRRM and WGRR

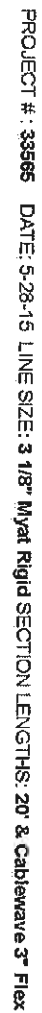


**Figure 2: Antenna Drawing for WRRM and WGRR**

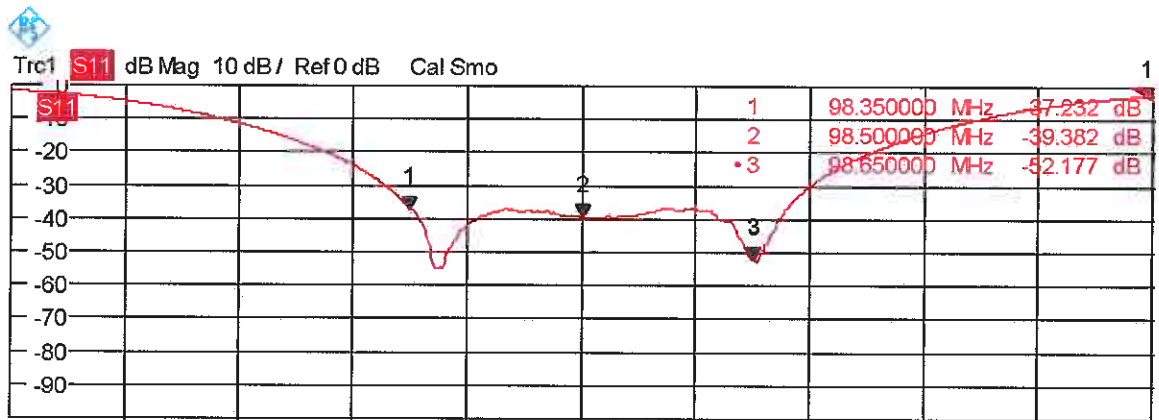


## Tuning Slug Location for Cincinnati, OH.

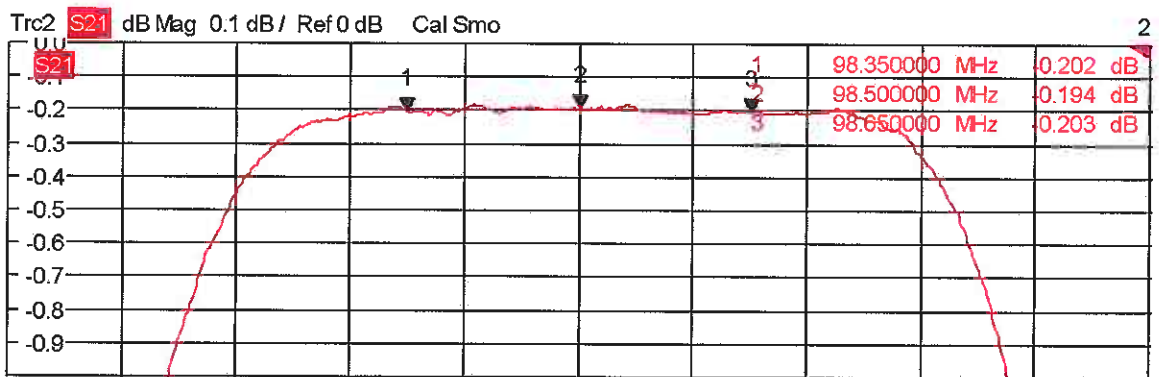
**SHPX-4AC-SF**



# **Measurement 1: Match and Insertion Loss of 98.5 MHz.**



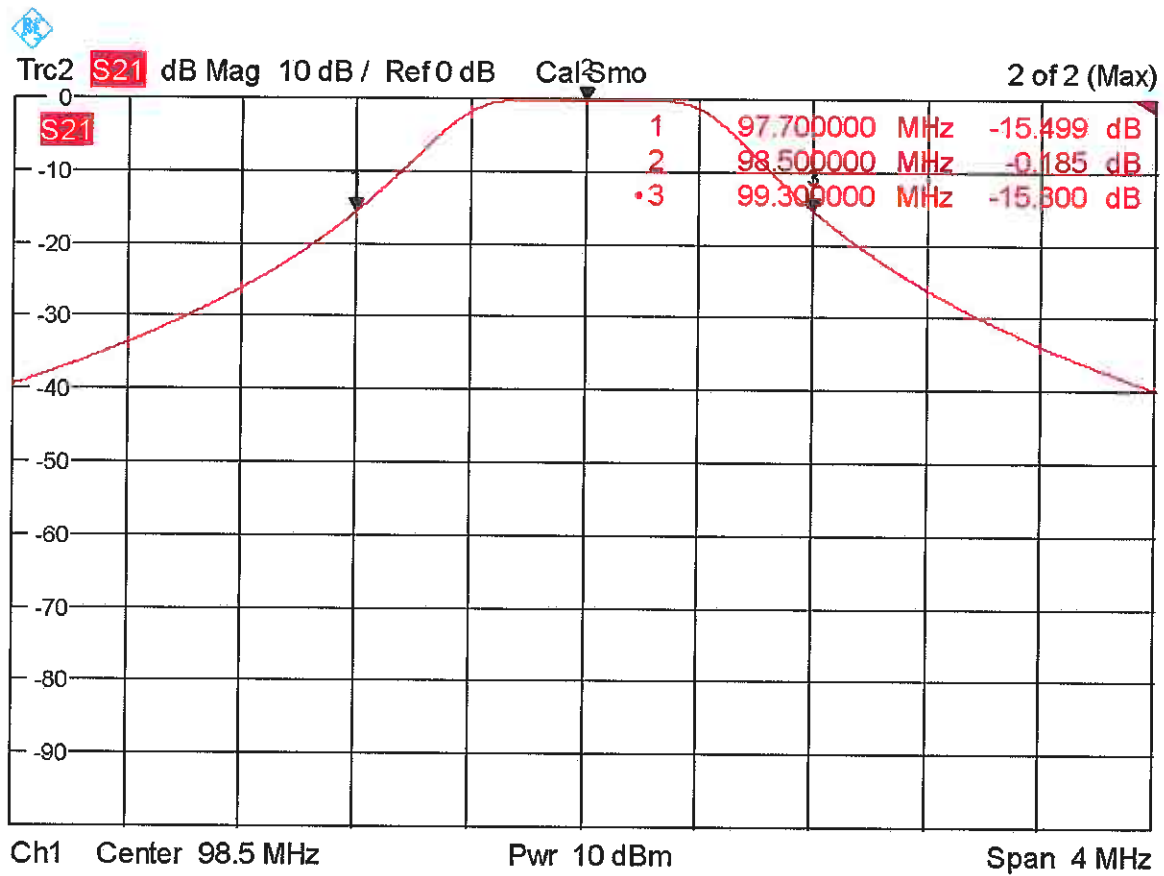
Ch1 Center 98.5 MHz Pwr 10 dBm Span 1 MHz



Ch1 Center 98.5 MHz Pwr 10 dBm Span 1 MHz

Date: 30.JUN.2015 15:27:06

**Measurement 2: Isolation +/- 800 KHz. of 98.5 MHz.**



Date: 30.JUN.2015 15:29:27



### Measurement 3: Group Delay of 98.5 MHz.



Trc2 **S21** Delay 50 ns/ Ref 780 ns Cal Smo

2 of 2 (Max)



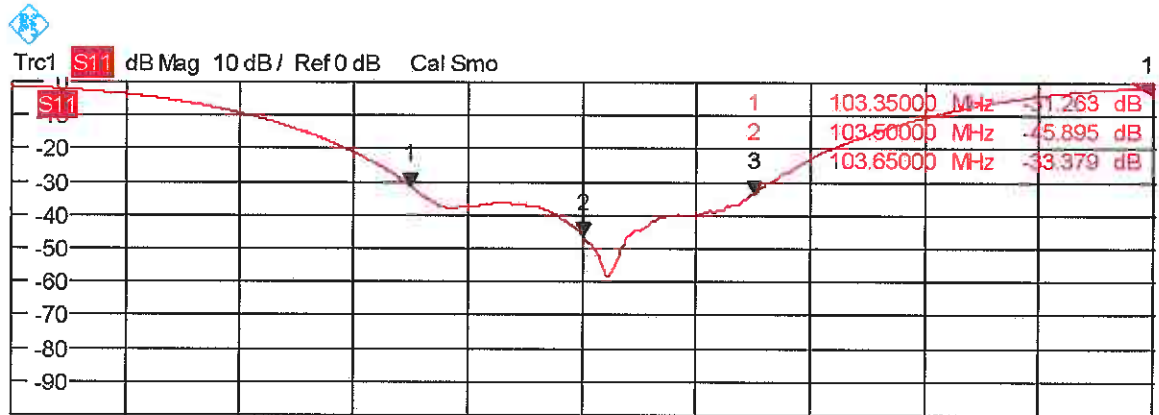
Ch1 Center 98.5 MHz

Pwr 10 dBm

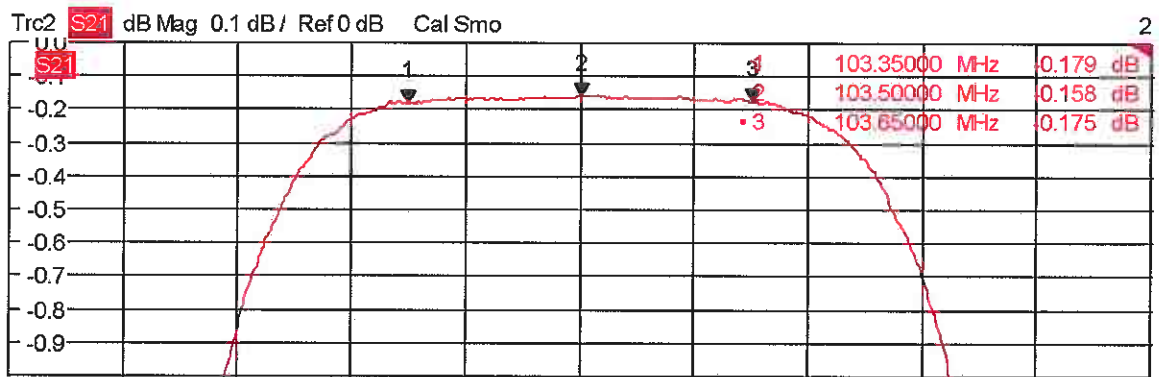
Span 1 MHz

Date: 30.JUN.2015 15:28:25

### Measurement 4: Match and Insertion Loss of 103.5 MHz.



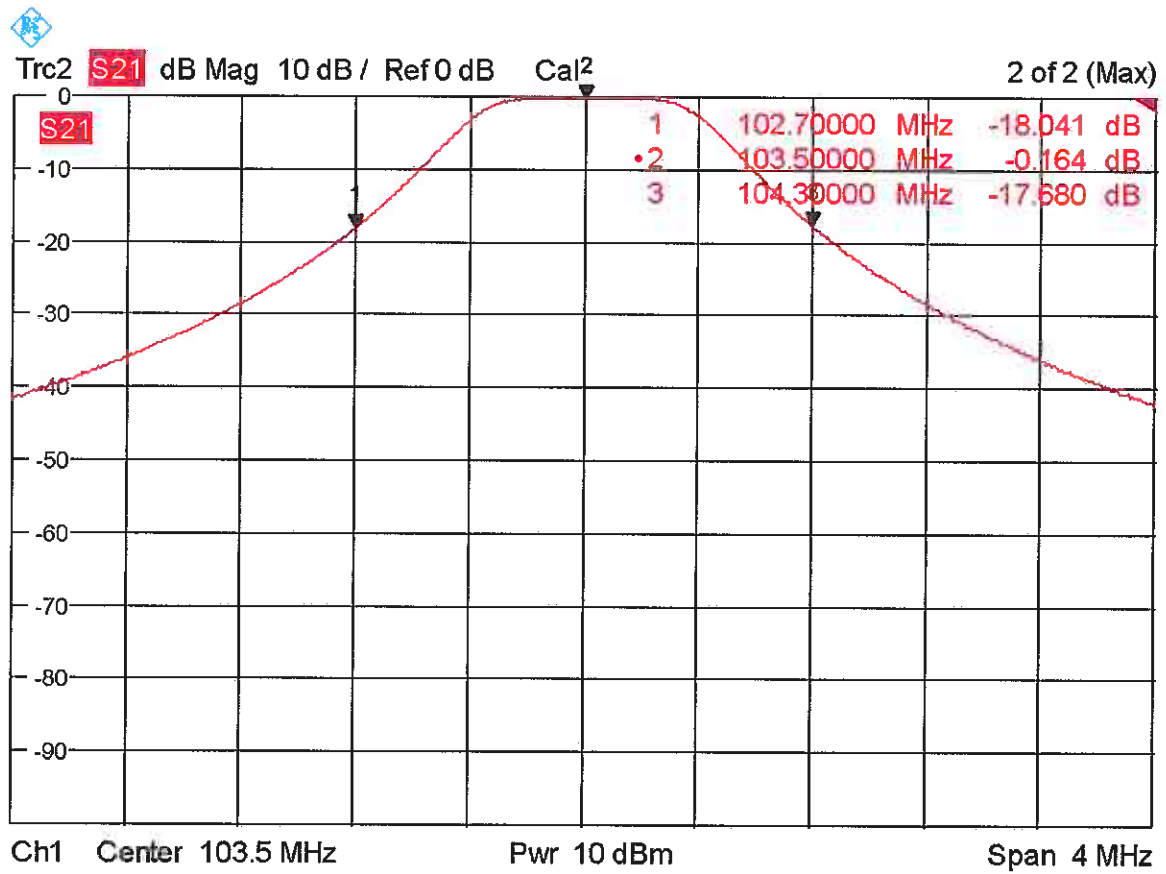
Ch1 Center 103.5 MHz Pwr 10 dBm Span 1 MHz



Ch1 Center 103.5 MHz Pwr 10 dBm Span 1 MHz

Date: 30.JUN.2015 15:31:16

**Measurement 5: Isolation +/- 800 KHz. of 103.5 MHz.**



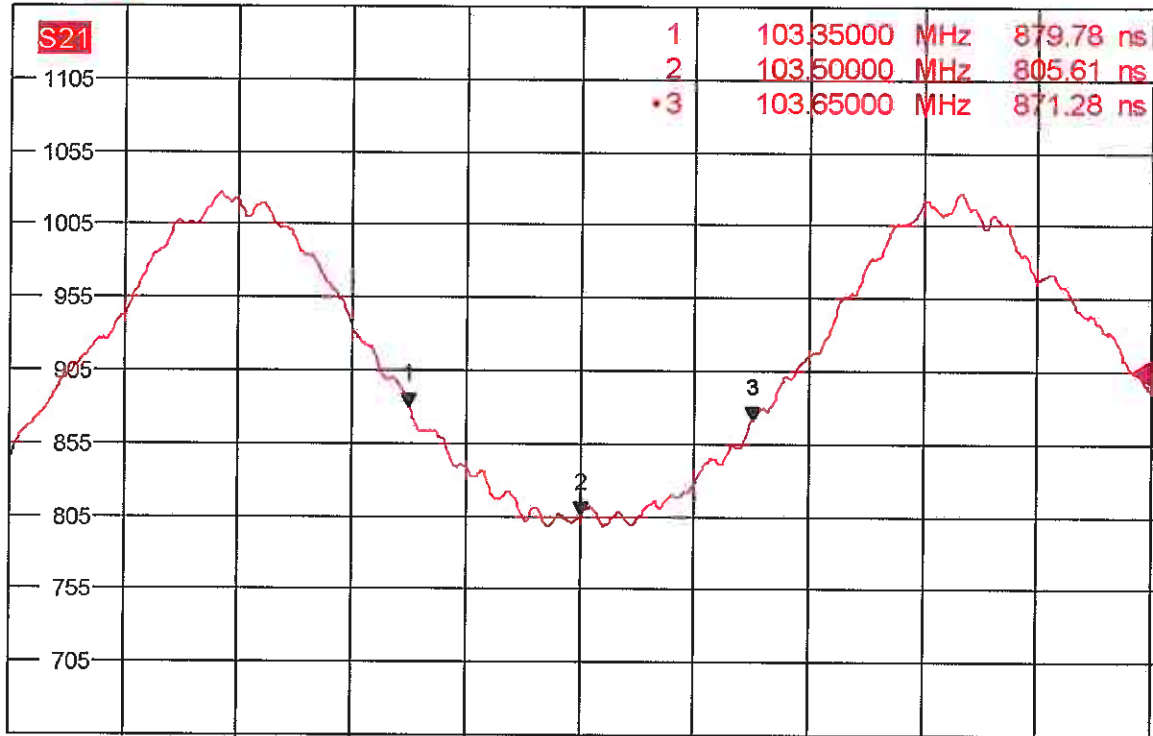
Date: 30.JUN.2015 15:33:04

# Measurement 6: Group Delay of 103.5 MHz.



Trc2 **S21** Delay 50 ns/ Ref 905 ns Cal Smo

2 of 2 (Max)



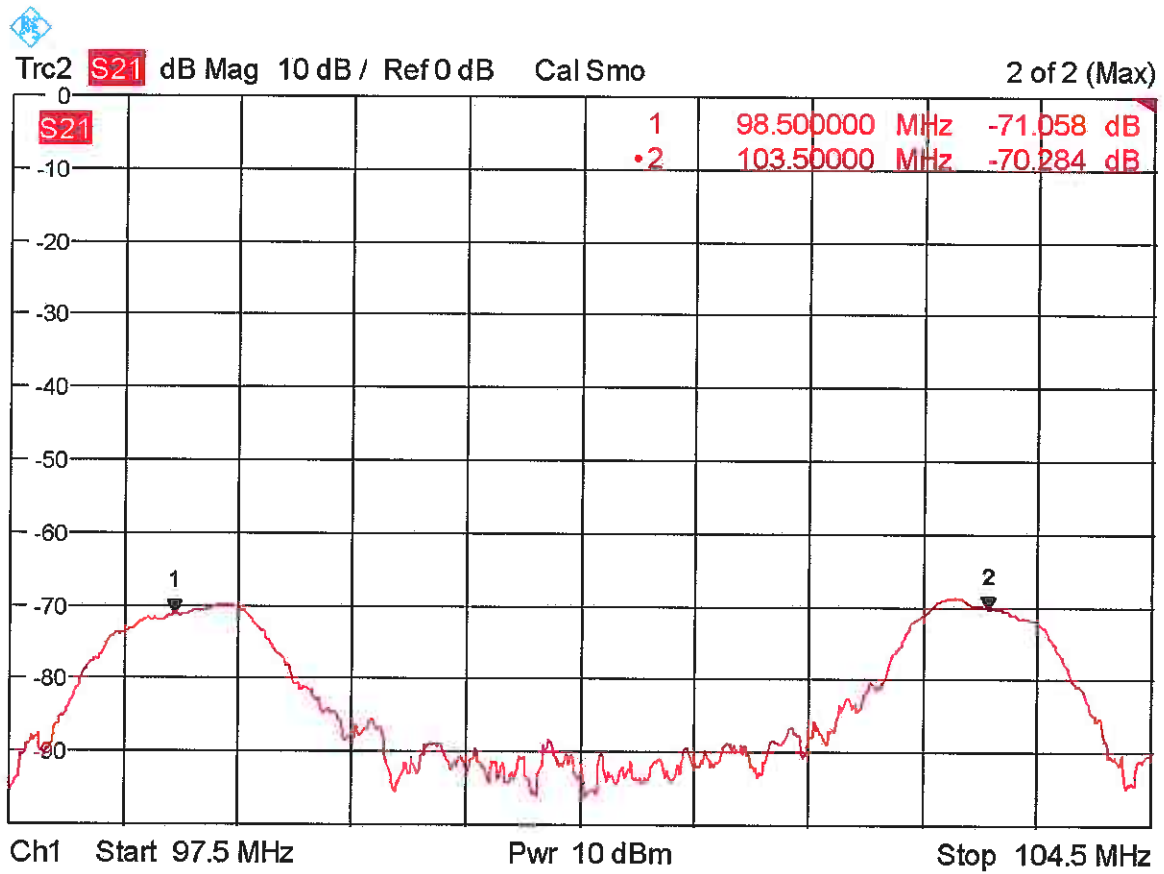
Ch1 Center 103.5 MHz

Pwr 10 dBm

Span 1 MHz

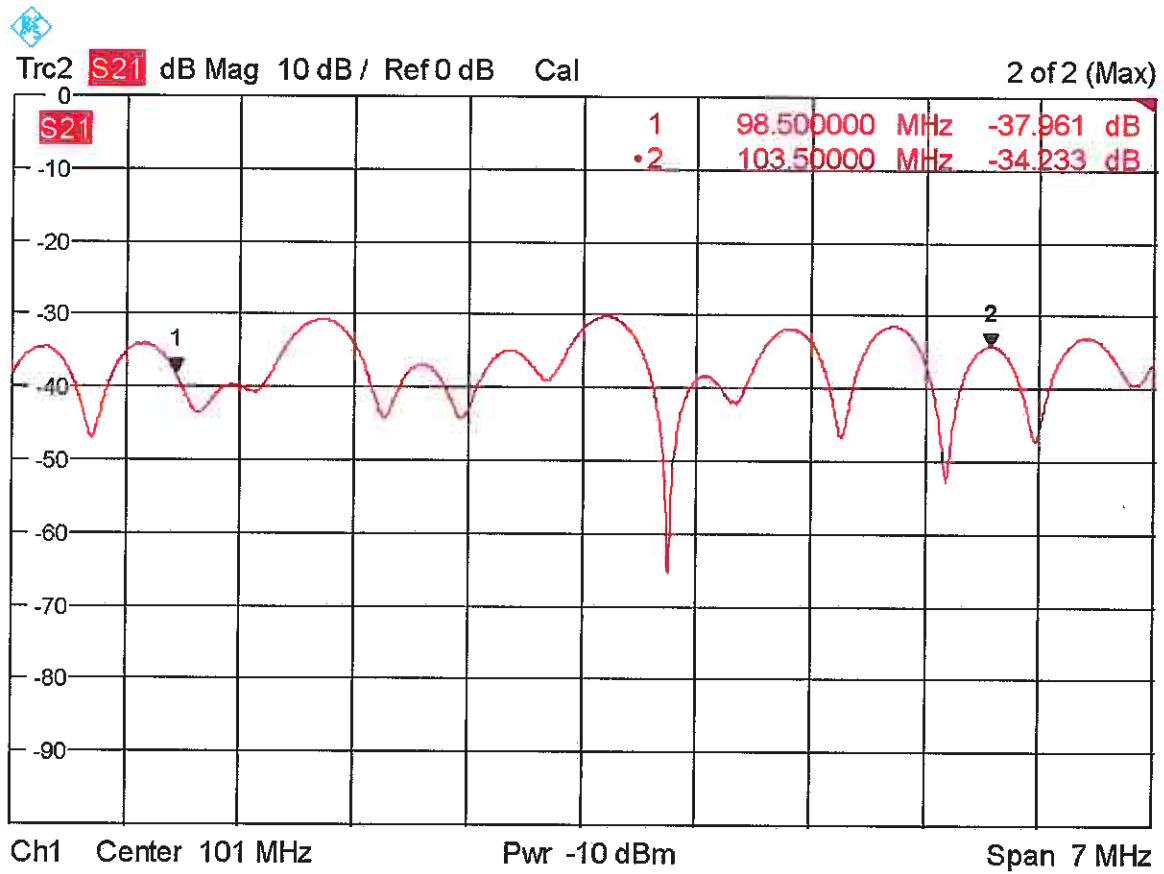
Date: 30.JUN.2015 15:32:14

### Measurement 7: Port to Port Isolation 98.5 to 103.5 MHz.



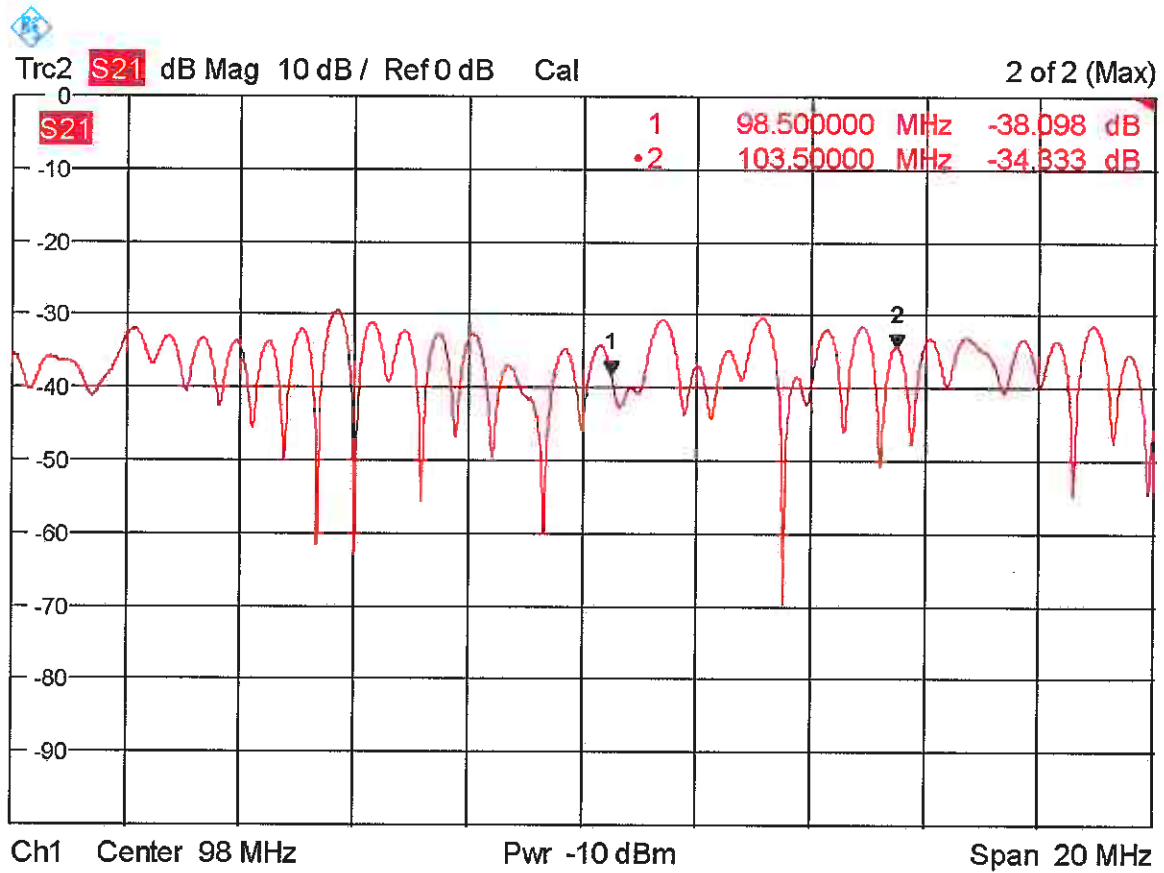
Date: 30.JUN.2015 15:35:16

### Measurement 8: Narrow Sweep of Feedline with 50 ohm Load.



Date: 2.JUN.2015 11:39:21

**Measurement 9: 88 to 108 MHz. Sweep of Feedline with 50 ohm Load.**



Date: 2.JUN.2015 11:41:38

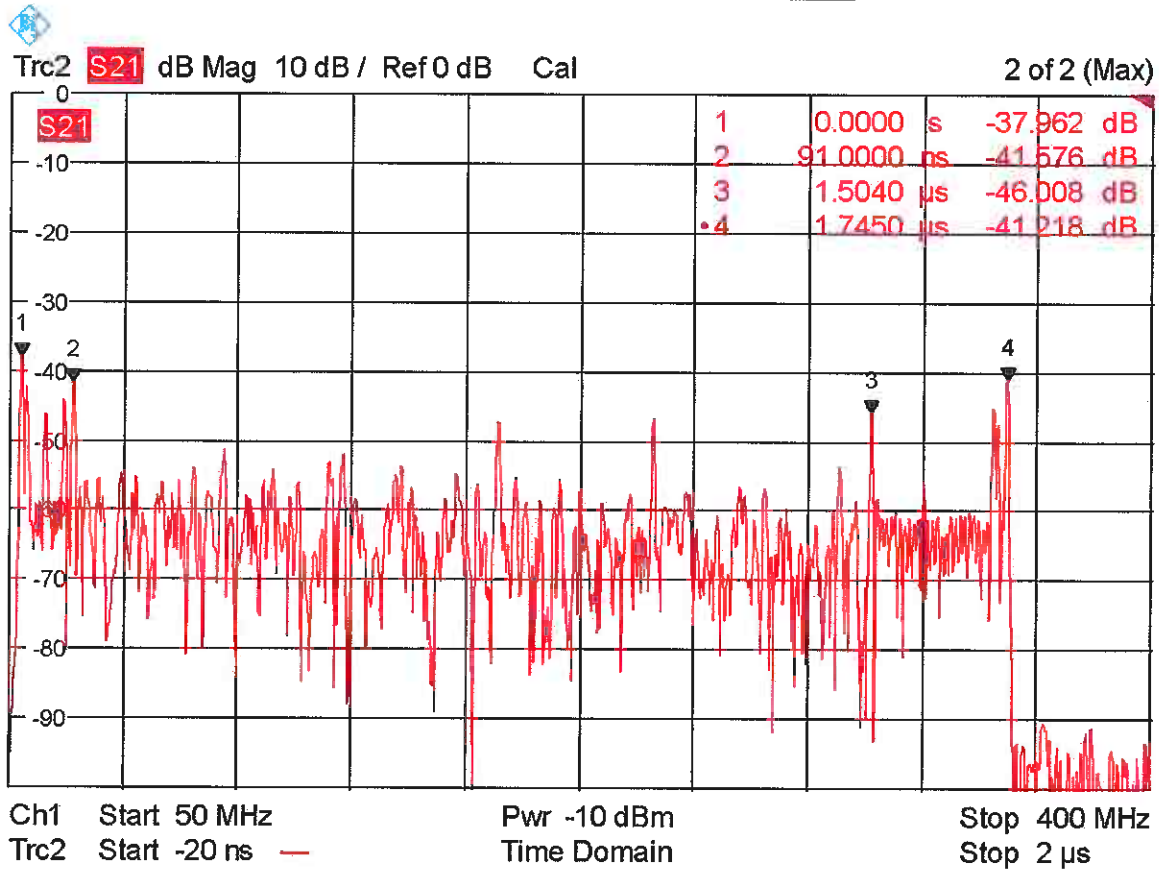
**Measurement 10: 50 to 400 MHz. Sweep of Feedline with 50 ohm Load TDR.**

Mkr#1 is Test Transition @ 0 Feet.

Mkr#2 is the Start of the Flex run @ Approx 45 Feet.

Mkr#3 is the End of the Flex Run @ Approx 709 Feet.

Mkr#4 is the 50 ohm Load @ Approx 857 Feet.

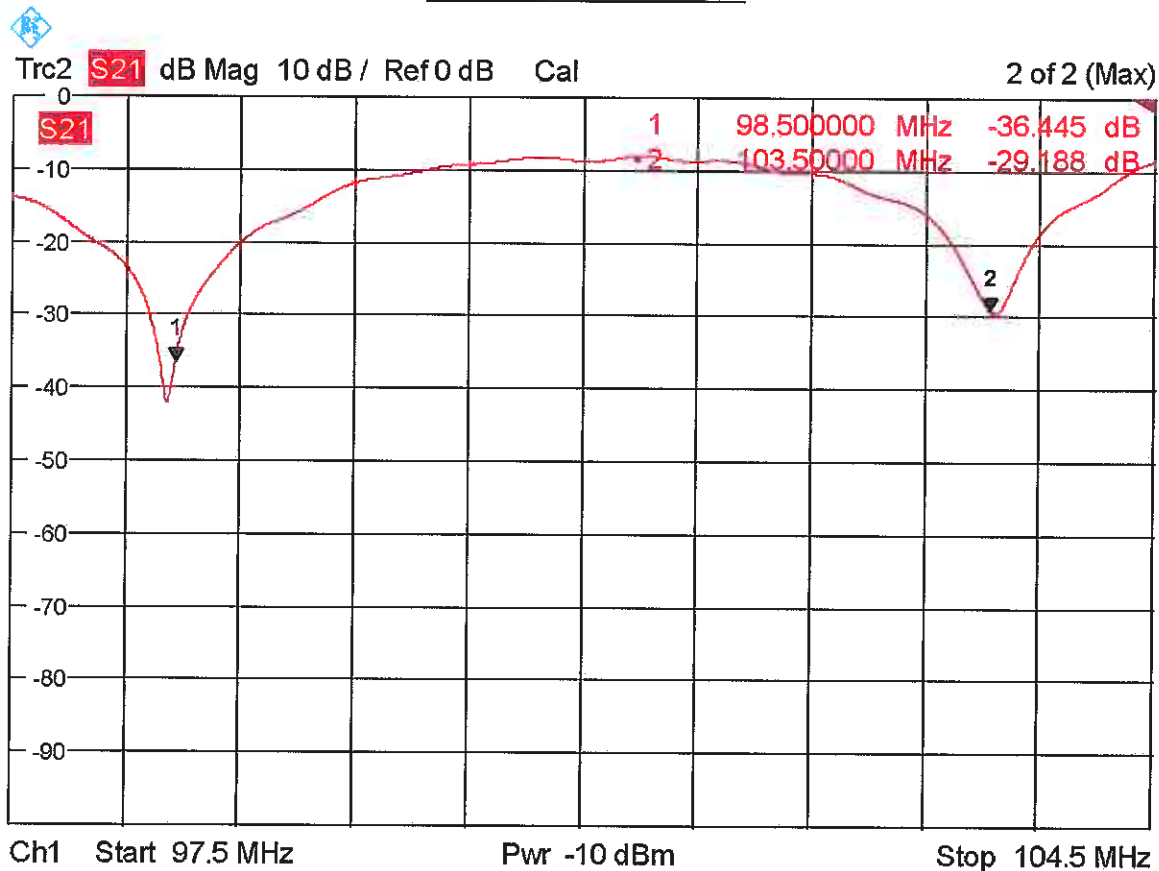


Date: 2.JUN.2015 11:45:04



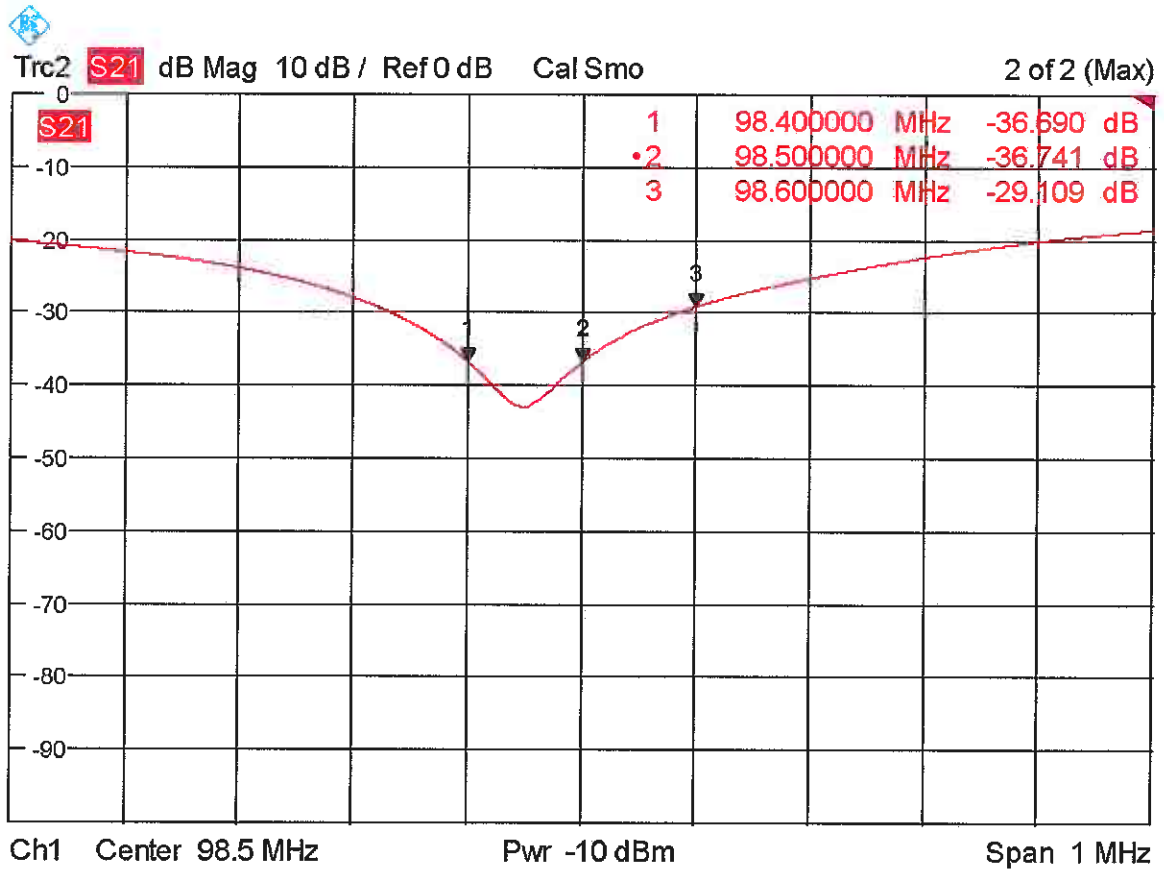
**Measurement 11: Narrow Sweep of Final Antenna 98.5 & 103.5 MHz.**

Return Loss Measurement.



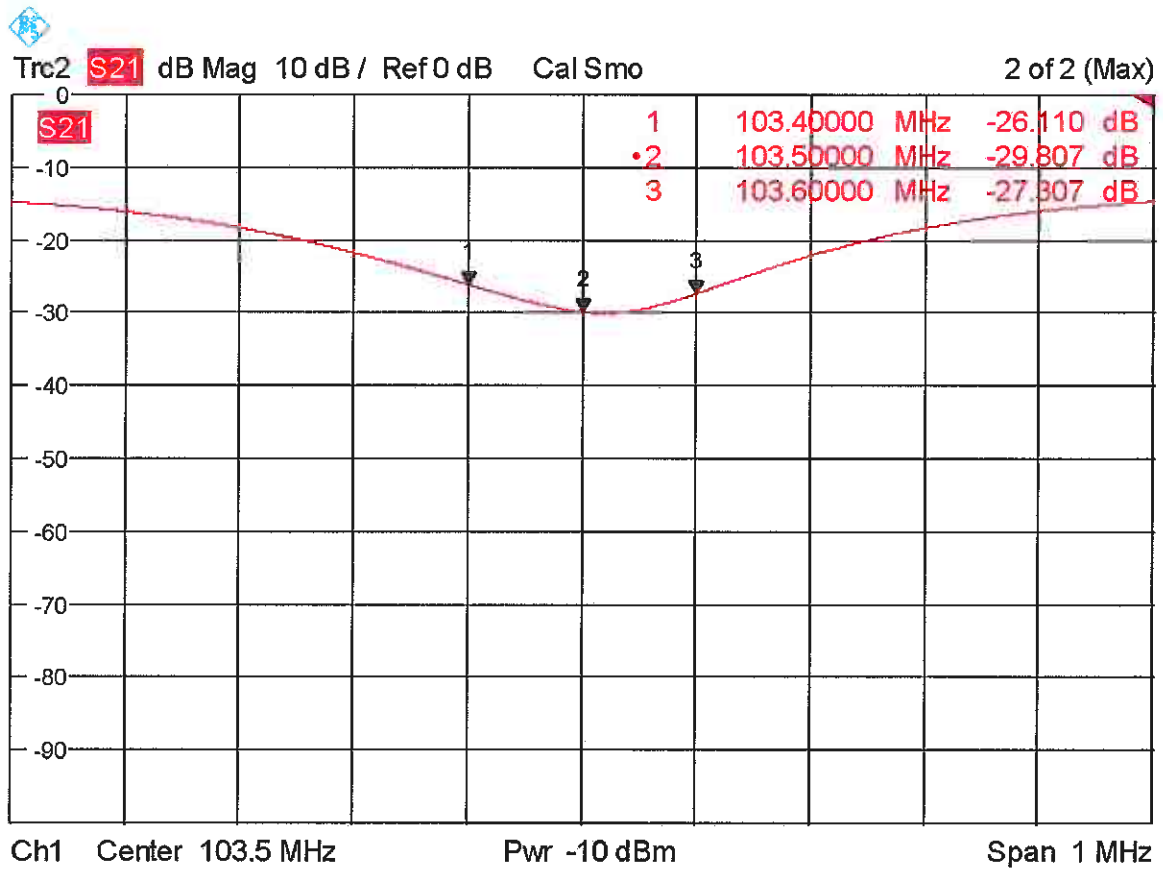
Date: 2.JUN.2015 13:11:39

**Measurement 13: Final Antenna 98.5 MHz. Return Loss Measurement.**



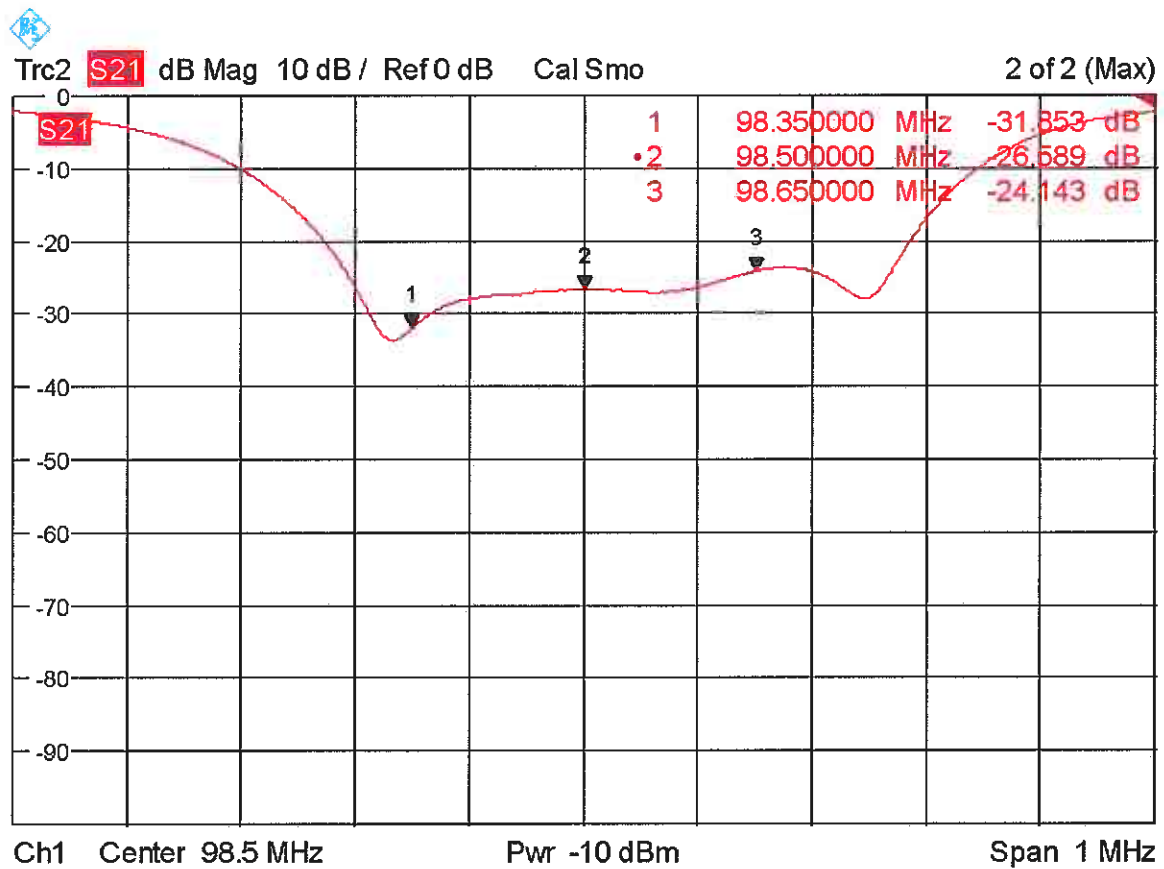
Date: 2.JUN.2015 14:04:10

**Measurement 14: Final Antenna 103.5 MHz. Return Loss Measurement.**



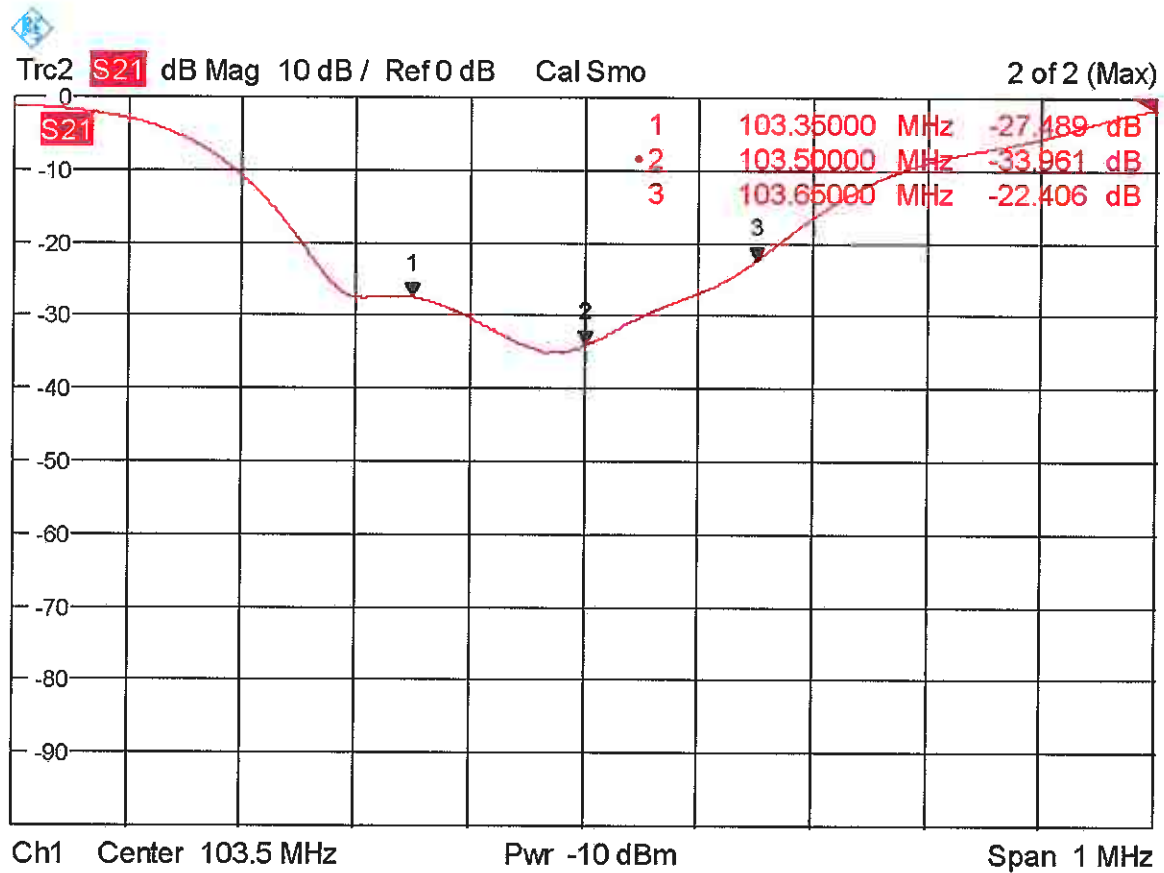
Date: 2.JUN.2015 14:06:29

**Measurement 15: Filter to Antenna of 98.5 MHz. Return Loss Measurement.**



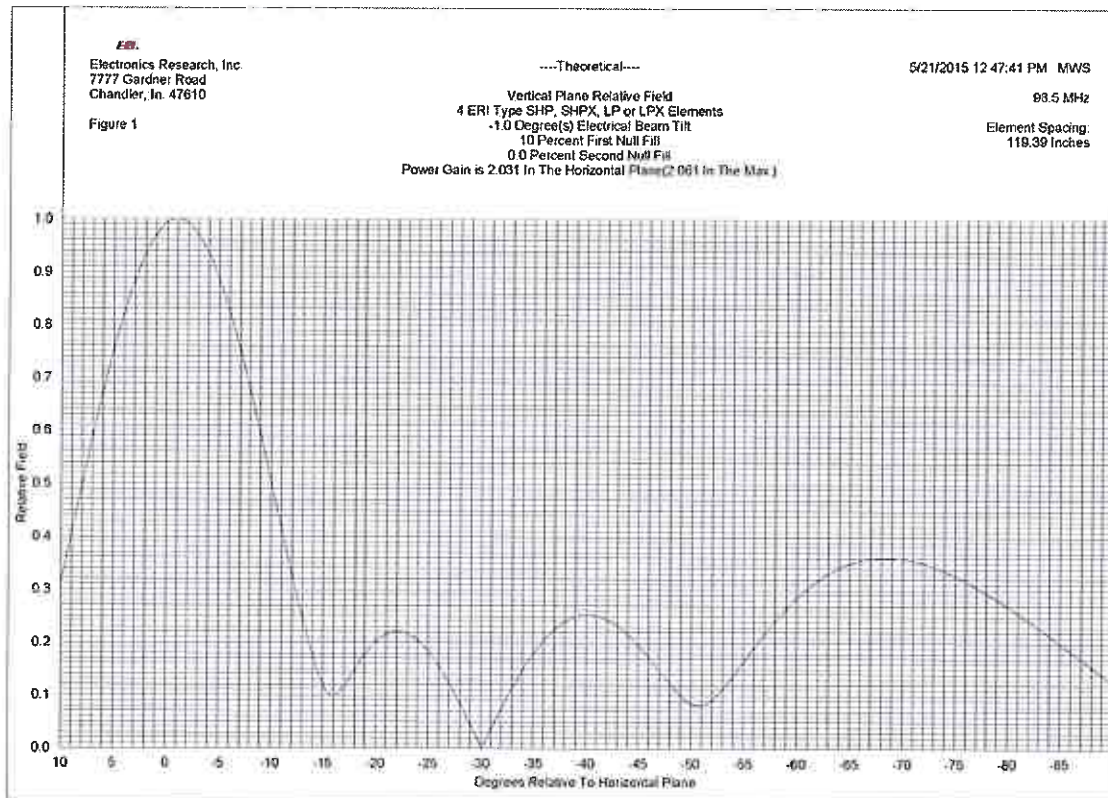
Date: 30.JUN.2015 16:21:51

**Measurement 16: Filter to Antenna of 103.5 MHz. Retrun Loss Measurement.**

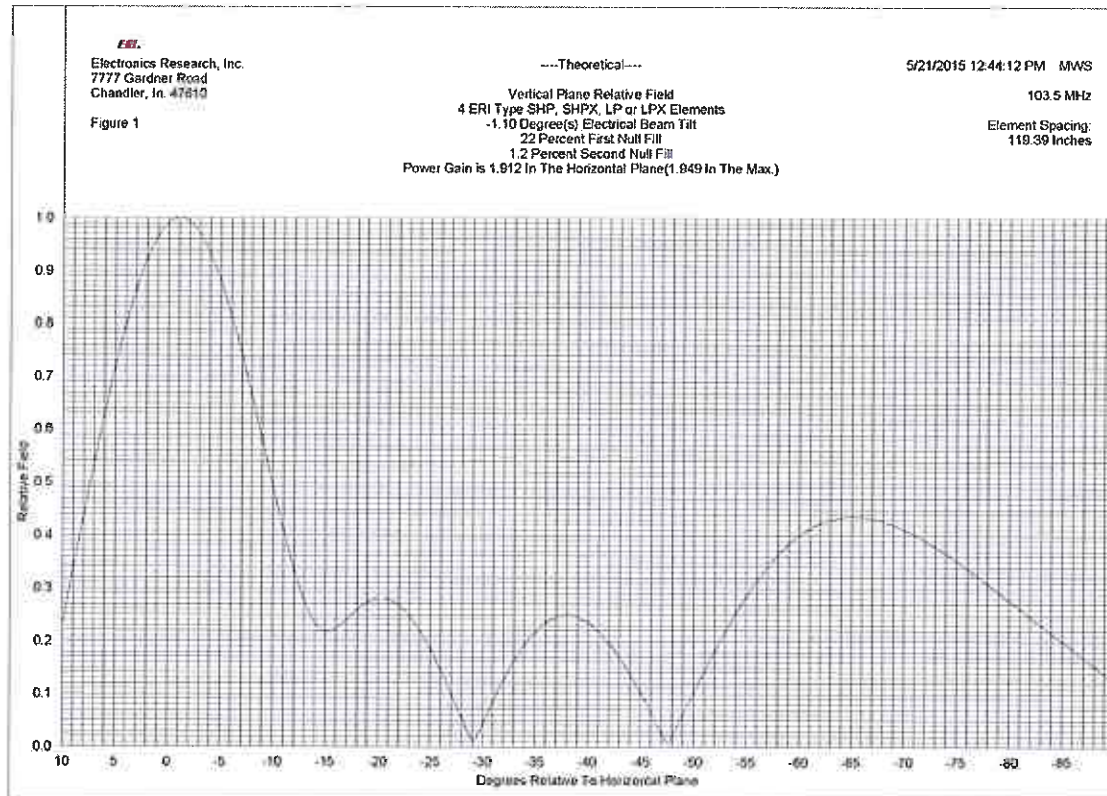


Date: 30.JUN.2015 16:18:37

**Figure 4: Vertical Plane relative Field Plot of 98.5 MHz.**



**Figure 5: Vertical Plane Relative Field Plot of 103.5 MHz.**



**Table 1: Loss Budget 98.5 MHz.**

**Power Analysis**

<b>Antenna Model:</b> SHPX-4AC-SP		
<b>Call Letters:</b> WRRM (FM)_		
<b>Frequency:</b> 98.5 MHz		
<b>ERP:</b>	18.000 kW	12.553 dBk
<b>Polarization:</b> Circular		
<b>Antenna Gain:</b>	2.061 Numeric	3.141 dB
<b>Antenna Input Power:</b>	8.734 kW	9.412 dBk
<b>Peak Voltage:</b> 935 volts		
<b>Transmission Line Type - Rigid Match:</b> 3-1/8-inch rigid line		
<b>Rigid Match Length:</b> 177 feet		
<b>Rigid Match Attenuation:</b> 0.092 dB/100-feet		
<b>Transmission Line Type - Semiflexible</b>		
<b>Run:</b> 3-inch flexible line		
<b>Semiflexible Run Length:</b> 666 feet		
<b>Semiflexible Run Attenuation:</b> 0.126 dB/100-feet		
<b>Line Loss:</b> -2.268 kW		1.003 dB
<b>Line Efficiency:</b> 79.387%		
<b>Power Output from Combiner:</b>	11.001 kW	10.414 dBk
<b>Peak Voltage:</b> 1,049 volts		
<b>Combiner Losses:</b> -0.503 kW		0.194 dB
<b>Transmitter Power Output:</b>	11.504 kW	10.608 dBk



**Table 2: Loss Budget Table 103.5 MHz.**

Call Letters:	WGRR (FM)	
Frequency:	103.5 MHz	
ERP:	3.000 kW	4.771 dBk
Polarization:	Circular	
Antenna Gain:	1.949 Numeric	2.898 dB
Antenna Input Power:	1.539 kW	1.873 dBk
Peak Voltage:	392 volts	
Transmission Line Type - Rigid Match:	3-1/8-inch rigid line	
Rigid Match Length:	177 feet	
Rigid Match Attenuation:	0.095 dB/100-feet	
Transmission Line Type - Semiflexible		
Run:	3-inch flexible line	
Semiflexible Run Length:	666 feet	
Semiflexible Run Attenuation:	0.130 dB/100-feet	
Line Loss:	-0.413 kW	1.033 dB
Line Efficiency:	78.827%	
Power Output from Combiner:	1.953 kW	2.906 dBk
Peak Voltage:	442 volts	
Combiner Losses:	-0.072 kW	0.158 dB
Transmitter Power Output:	2.025 kW	3.064 dBk