

# **Field Service Report**

## **FM Combiner and Antenna System**

Cincinnati, OH.  
ERI Antenna SHPX-4AC-SP  
ERI 973-4 "TEE" Combiner  
with Low Level Group Delay  
Feedline: Dielectric 3 1/8" Rigid

Combiner System  
WGUC – 90.9 MHz.  
WVXU – 91.7 MHz.

ERI Project # 27122

October 29, 2010

### **Submitted By:**

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## **INTRODUCTION**

Listed below is a summary of the data and attached are the plots collected from the WGUC ~ WVXU transmission site in Cincinnati, OH. by Jeff Taylor December 2, 2010.

- The antenna is a SHPX-4AC-SP.
- The combiner is a 973-4 "TEE" Combiner with Forced Air Cooling and Low Level Group Delay.
- Equipment used for combiner testing is an Rohde & Schwarz ZVL Network Analyzer.
- Equipment used for antenna testing is an Rohde & Schwarz ZVL Network Analyzer High RF setup.
- All measurements of the combiner were taken at the input of each filter bank on the 3 1/8" elbow and at the 6" to 3" inch reducer on the output side of the "TEE".
- All measurements of the antenna were taken at the output of the 97.1MHz. transmitter.

The reason for this Field Service Trip was to install the "TEE" combiner, tune the antenna, and proof the system.

## **SUMMARY and RECOMMENDATIONS**

All measurements were taken by Jeff Taylor of Electronics Research Inc. December, 2010.

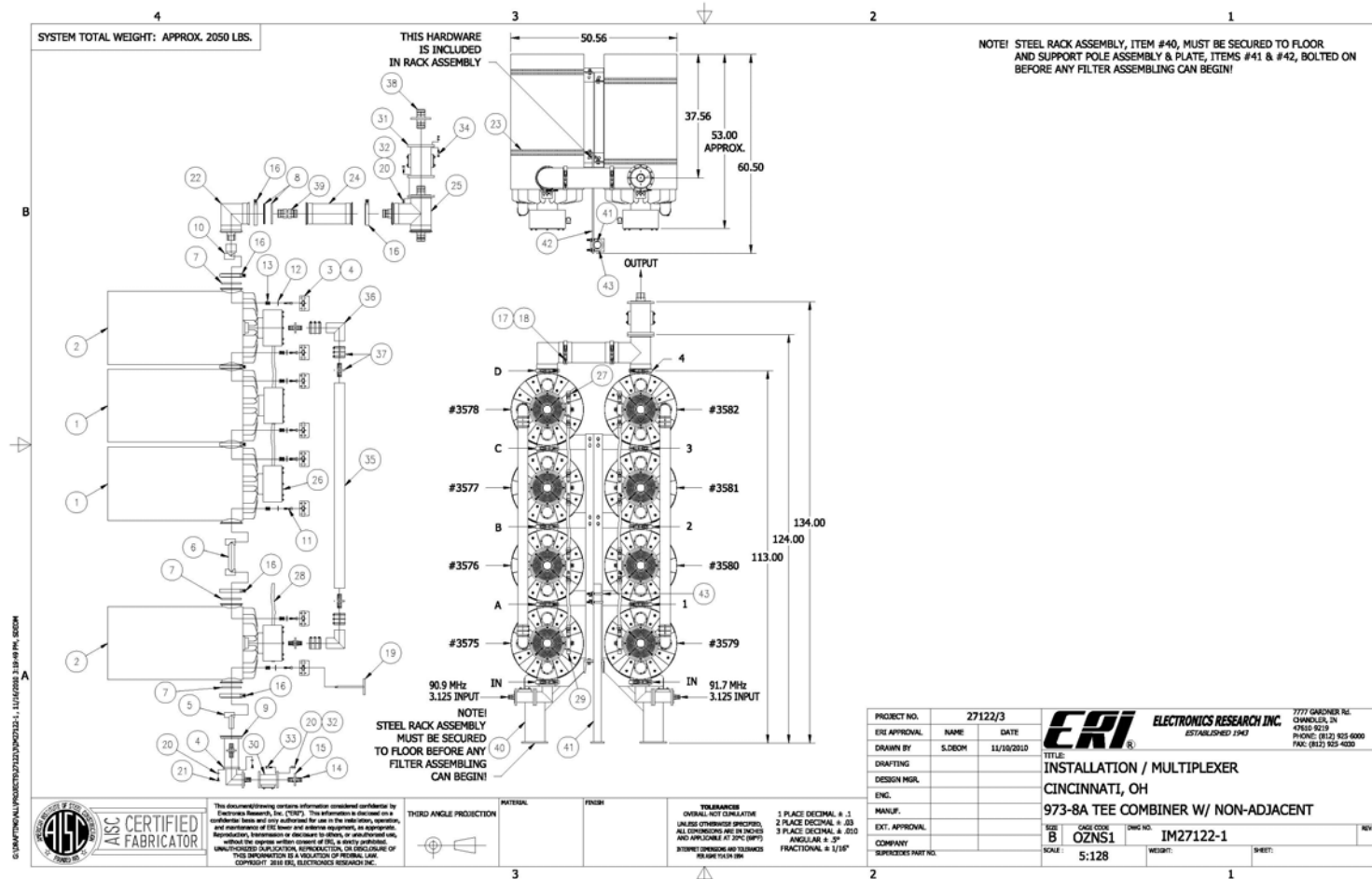
Sincerely

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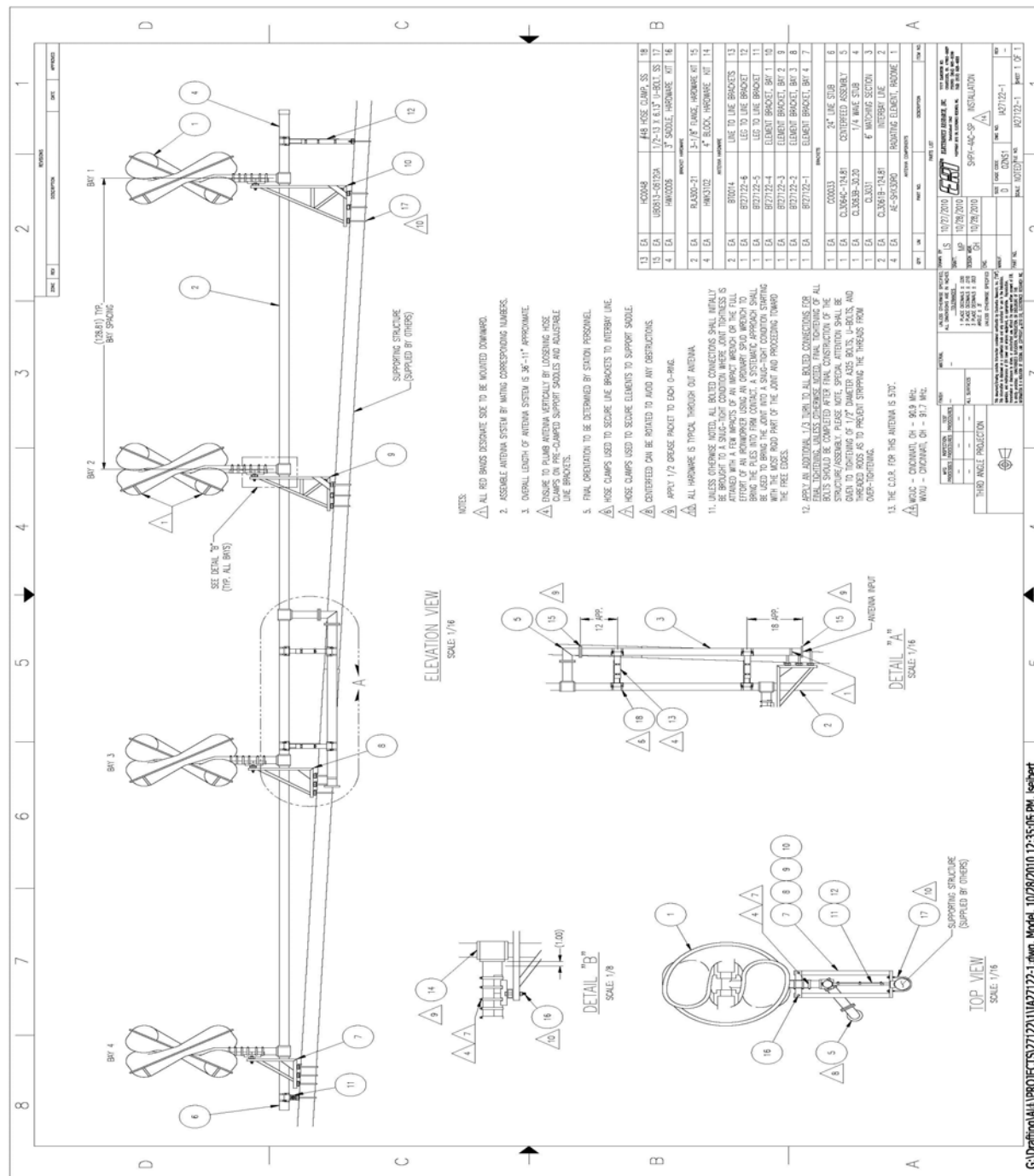
Jeff Taylor

# DRAWINGS

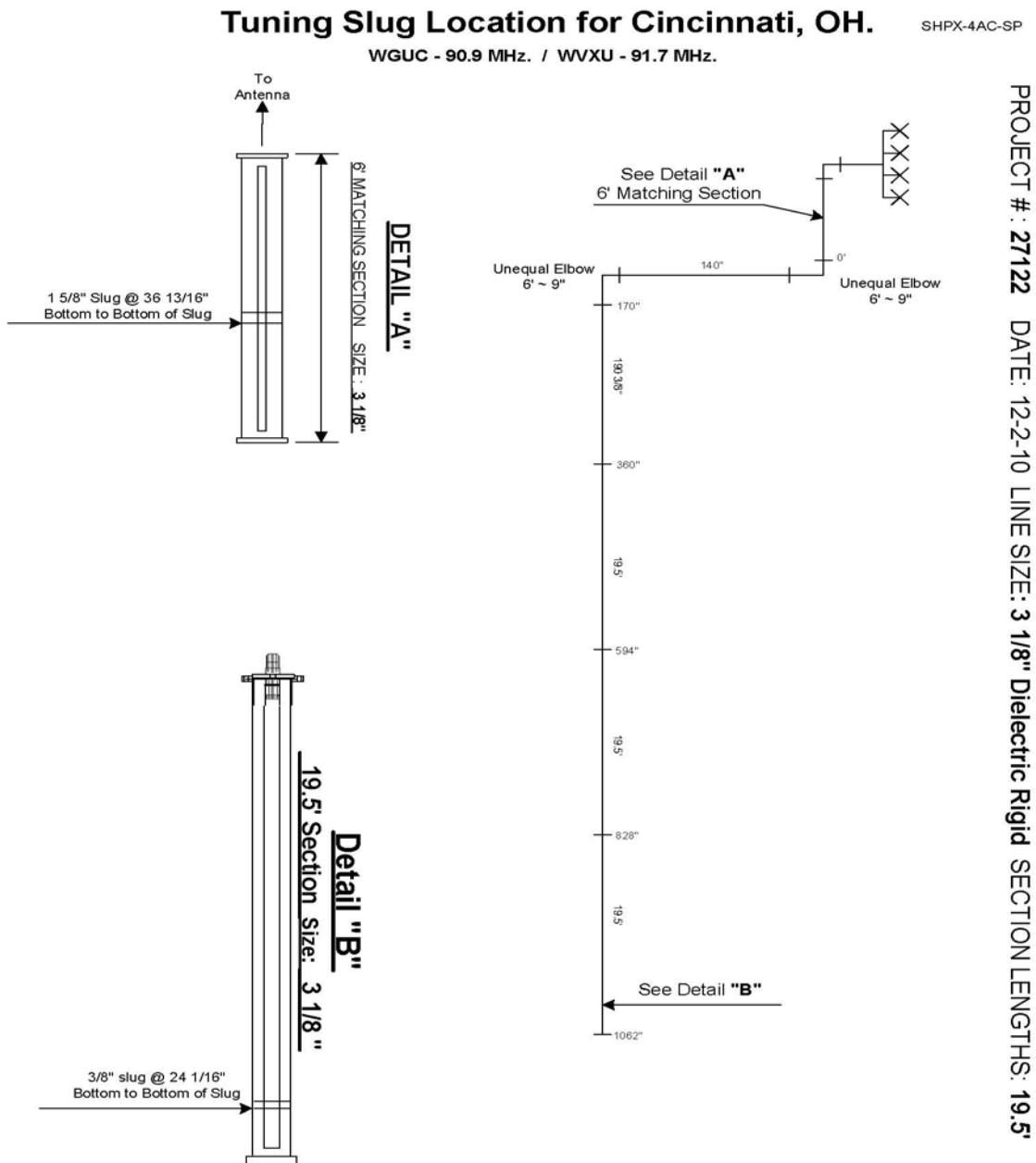
Figure 1: Combiner Drawing



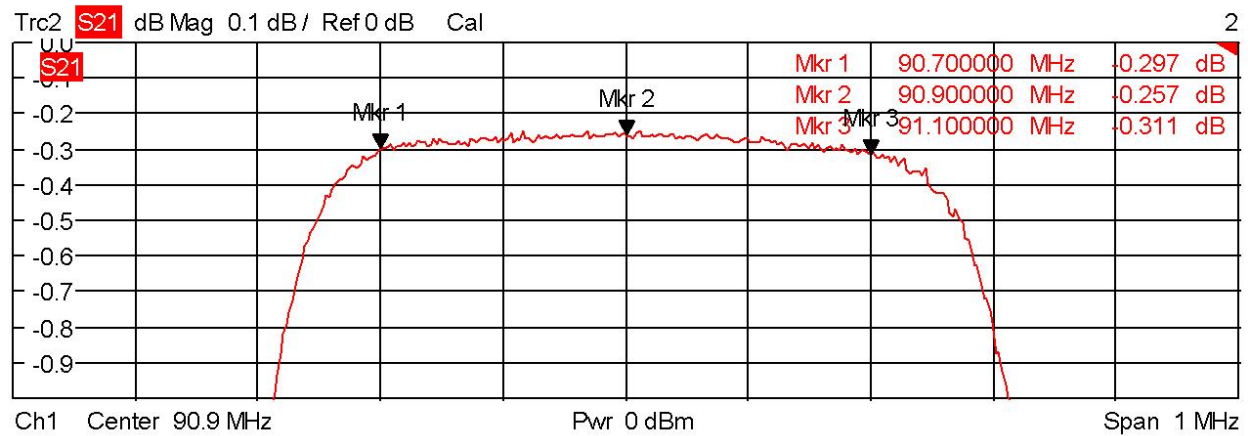
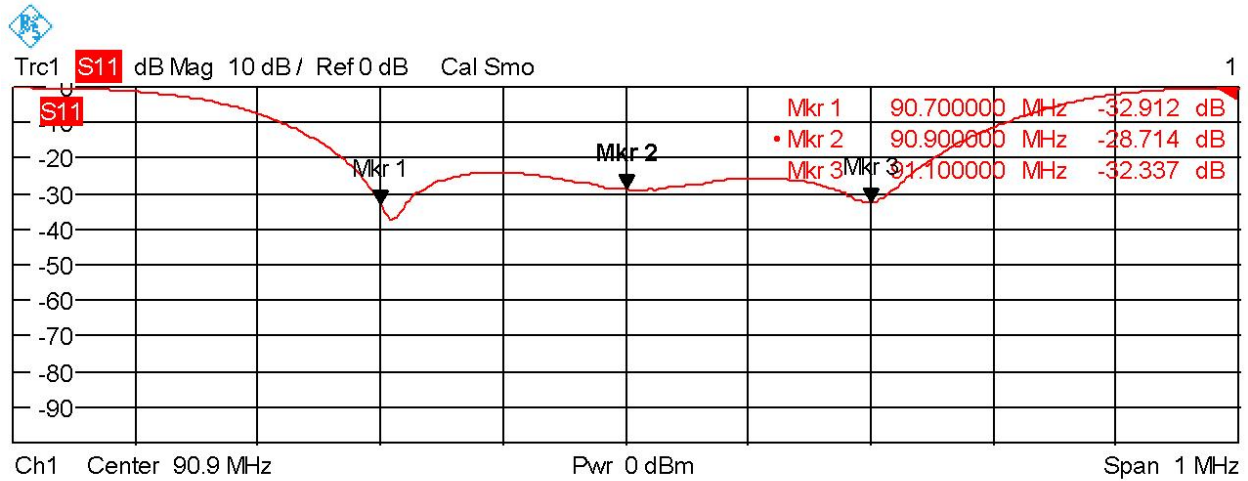
### Figure 2: Antenna Drawing



**Figure 3: Feedline Tuning Slug Location.**

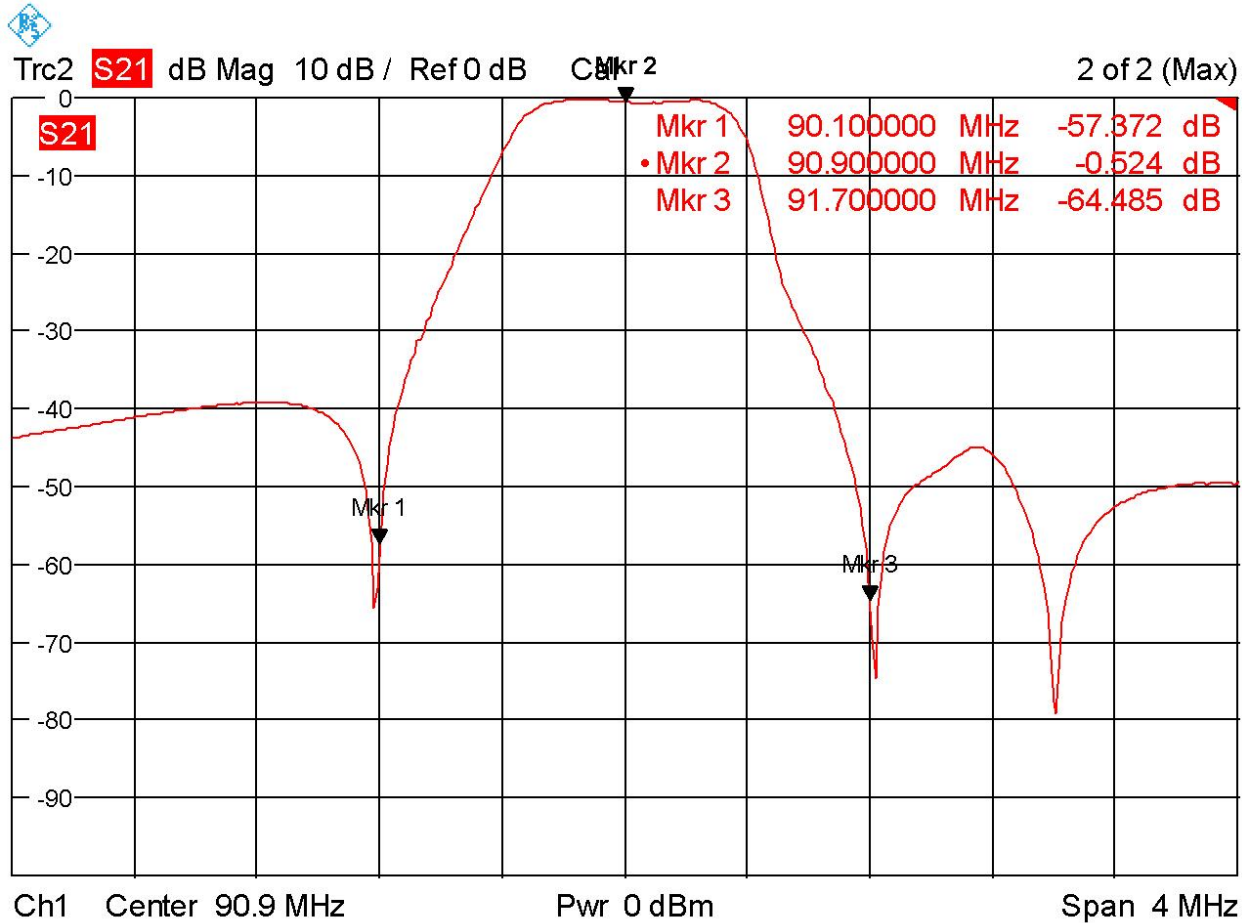


## Measurement 1: Match and Insertion Loss of 90.9 MHz.



Date: 3.DEC.2010 16:52:17

**Measurement 2: Isolation +/- 800 KHz. of 90.9 MHz.**



Date: 3.DEC.2010 16:53:20

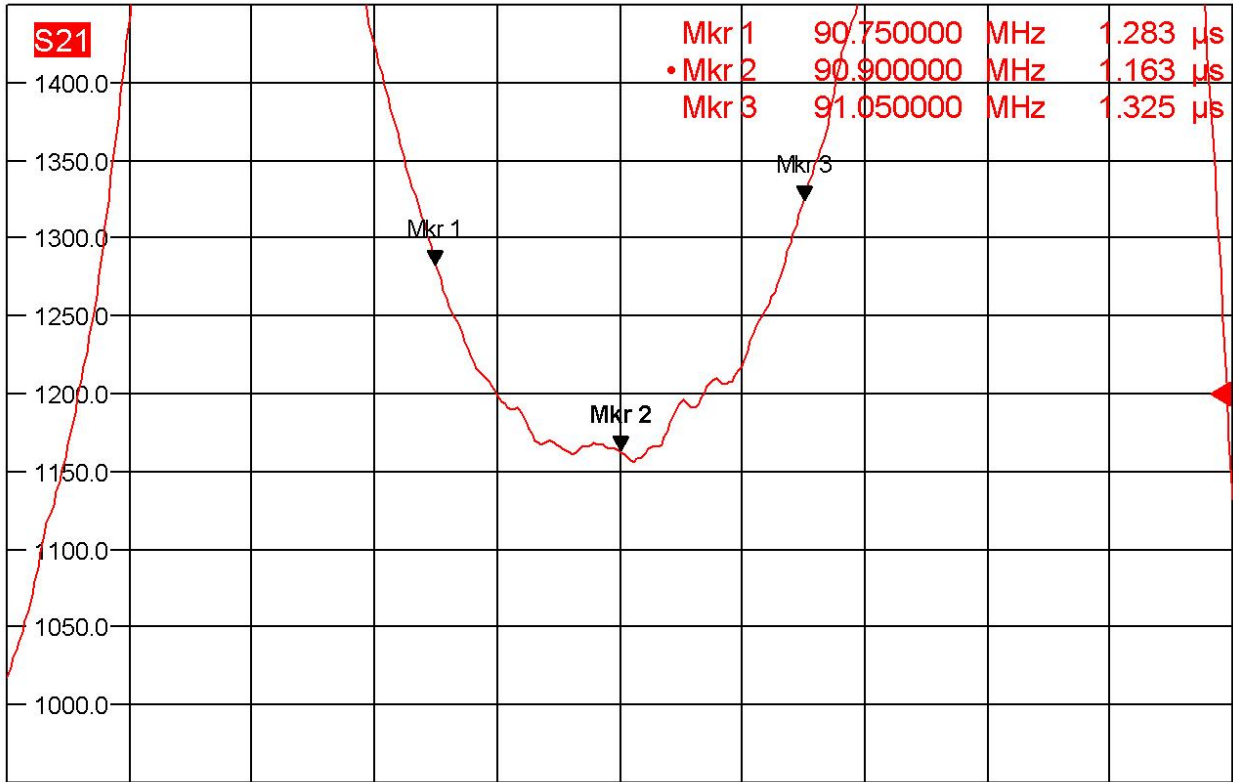


**Measurement 3: Group Delay of 90.9 MHz.**



Trc2 **S21** Delay 50 ns/ Ref 1.2  $\mu$ s Cal Smo

2 of 2 (Max)



Ch1 Center 90.9 MHz

Pwr 0 dBm

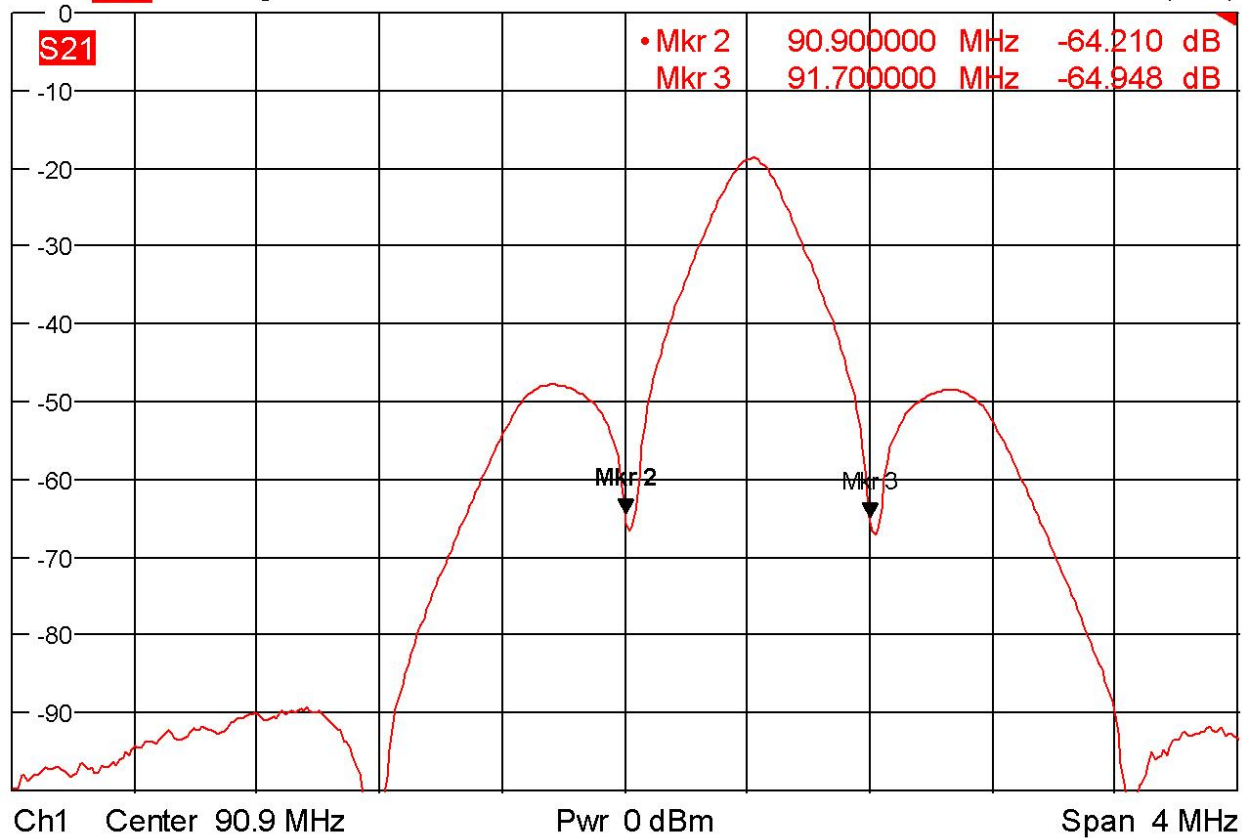
Span 1 MHz

Date: 3.DEC.2010 16:54:34

#### Measurement 4: Port to Port Isolation from 90.9 to 91.7 MHz.

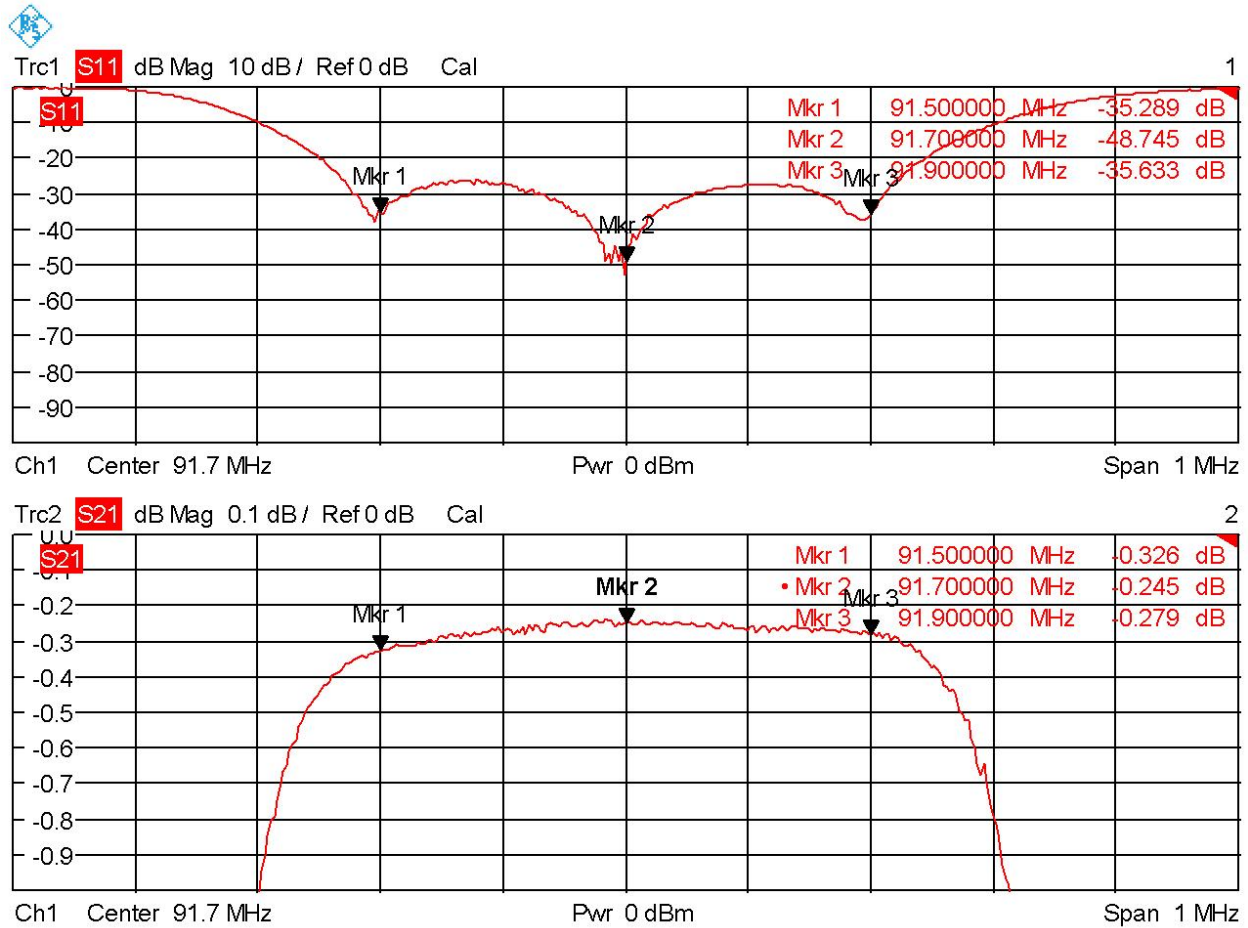


Trc2 **S21** dB Mag 10 dB / Ref 0 dB Cal Smo 2 of 2 (Max)



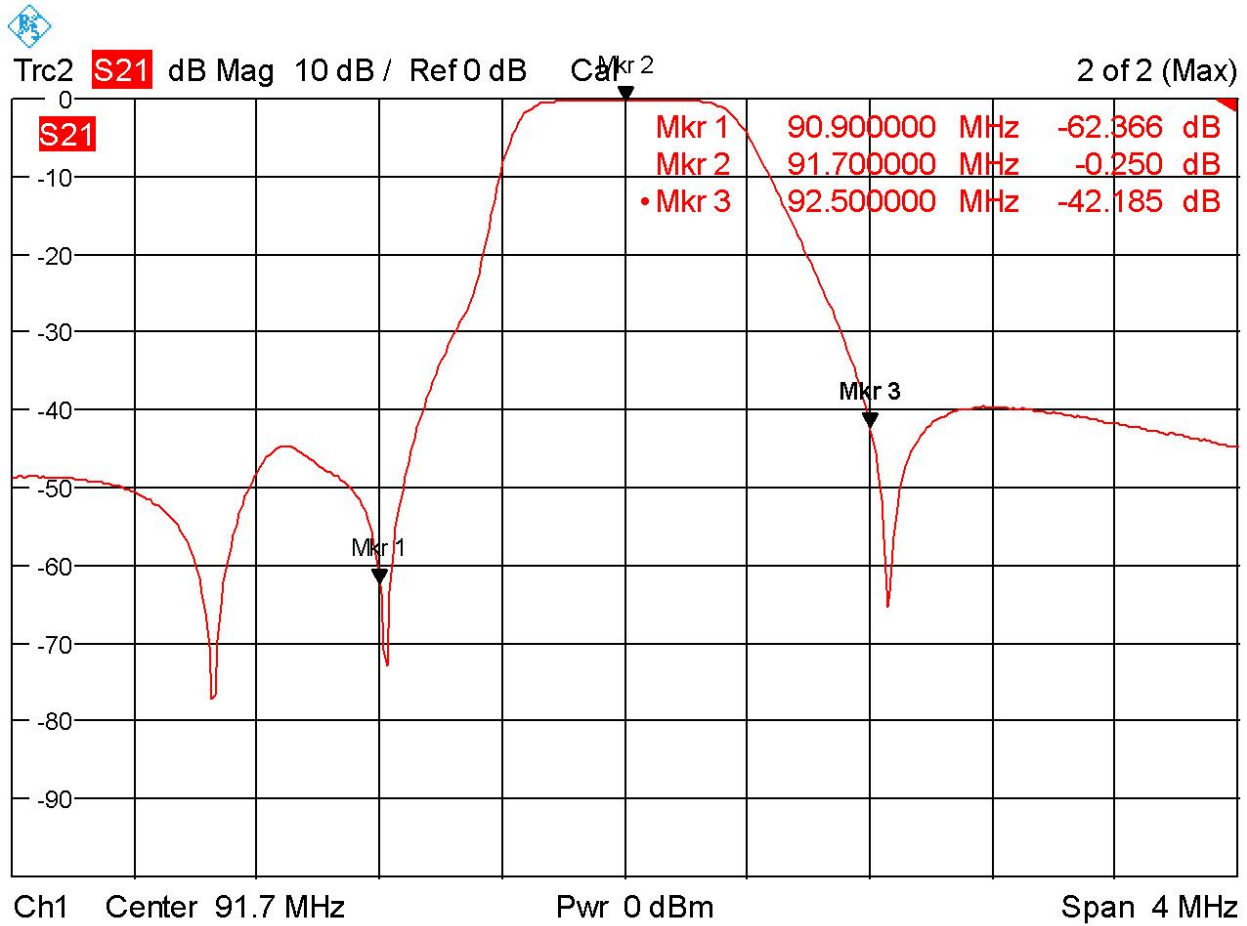
Date: 3.DEC.2010 16:39:07

## Measurement 5: Match and Insertion Loss of 91.7 MHz.



Date: 3.DEC.2010 16:44:12

**Measurement 6: Isolation +/- 800 KHz. of 91.7 MHz.**

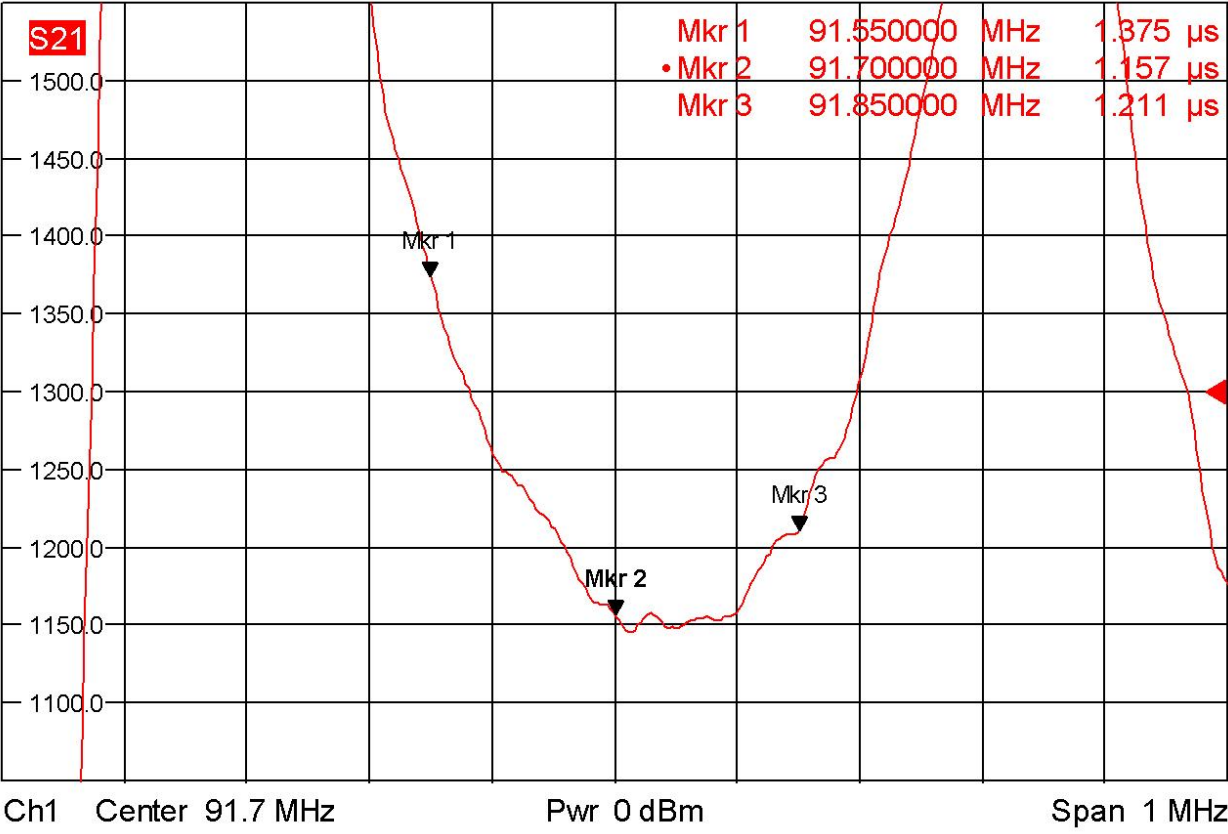


Date: 3.DEC.2010 16:42:55

**Measurement 7: Group Delay of 91.7 MHz.**



Trc2 **S21** Delay 50 ns/ Ref 1.3  $\mu$ s Cal Smo 2 of 2 (Max)



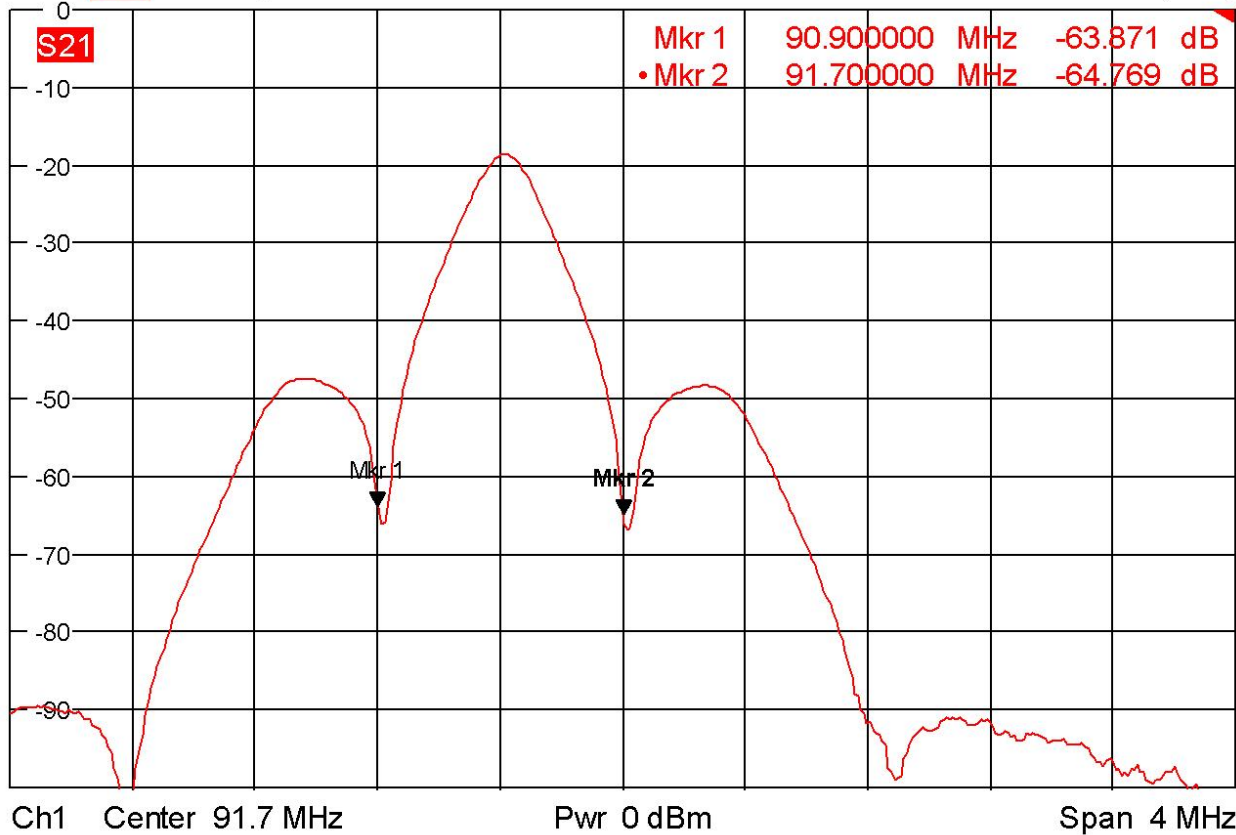
Date: 3.DEC.2010 16:45:49

### Measurement 8: Port to Port Isolation from 91.7 to 90.9 MHz.



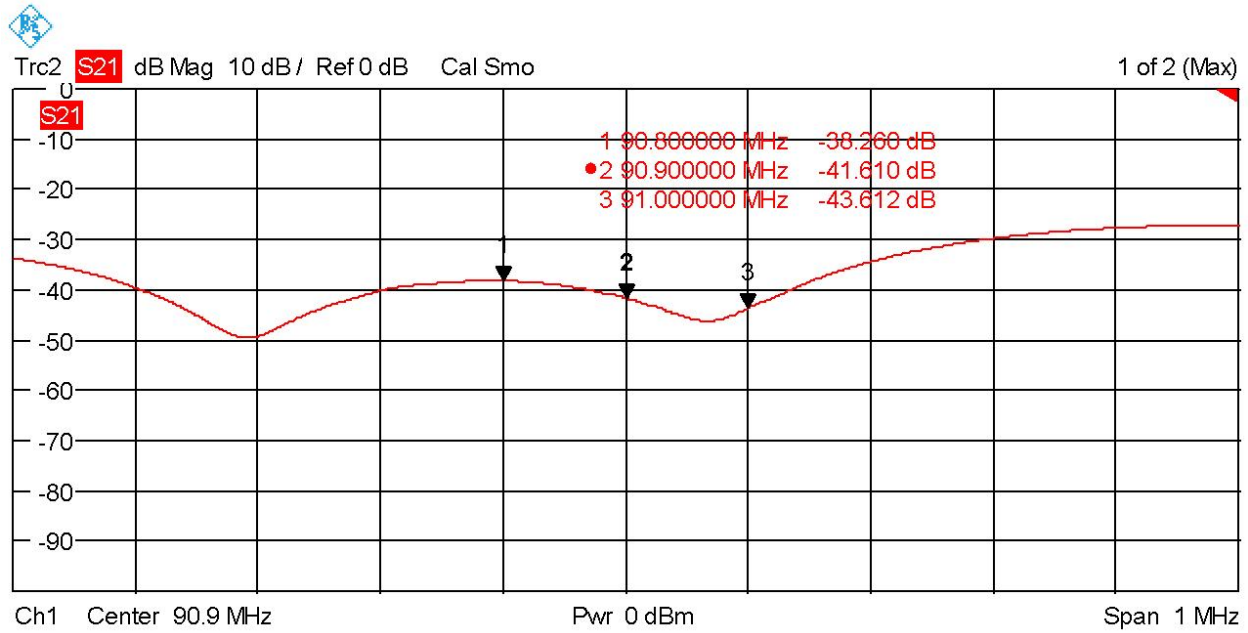
Trc2 **S21** dB Mag 10 dB / Ref 0 dB Cal Smo

2 of 2 (Max)



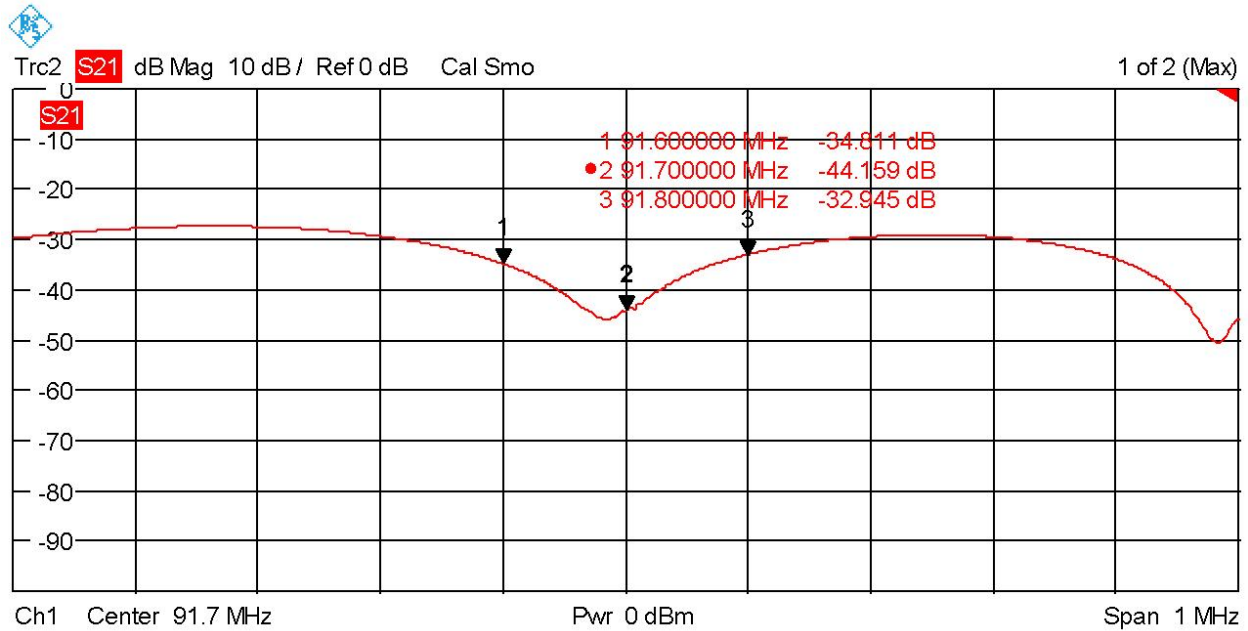
Date: 3.DEC.2010 16:40:44

### Measurement 9: Final Antenna Match of 90.9 MHz.



Date: 2.DEC.2010 14:47:02

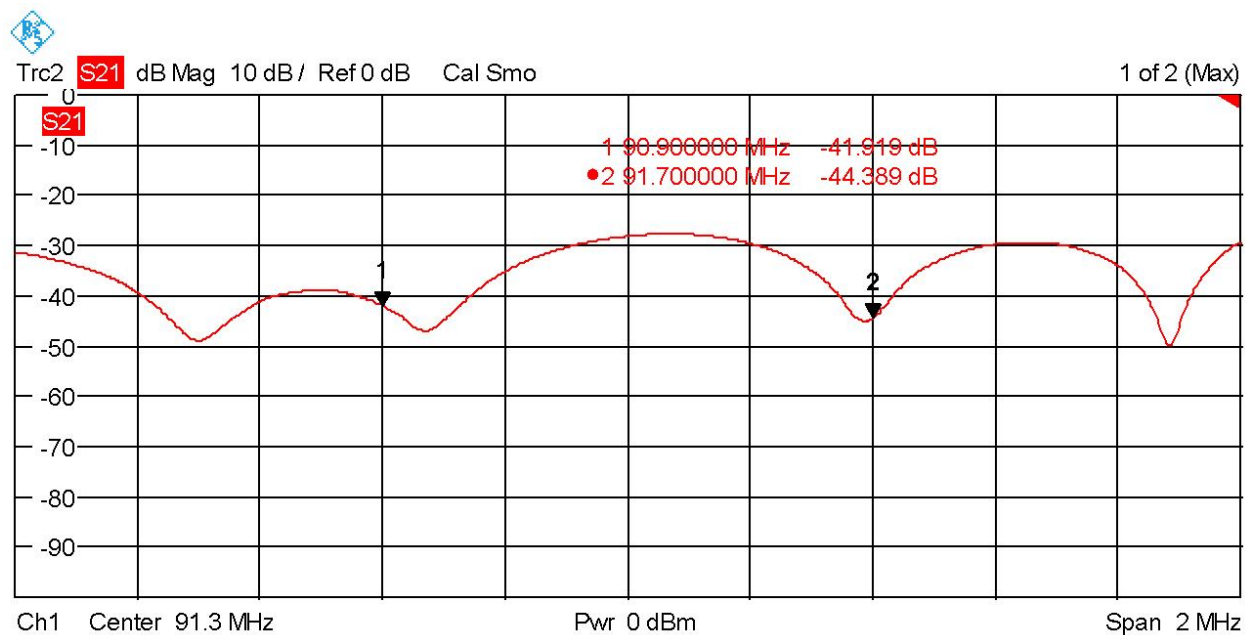
### Measurement 10: Final Antenna Match of 91.7 MHz.



Date: 2.DEC.2010 14:48:52

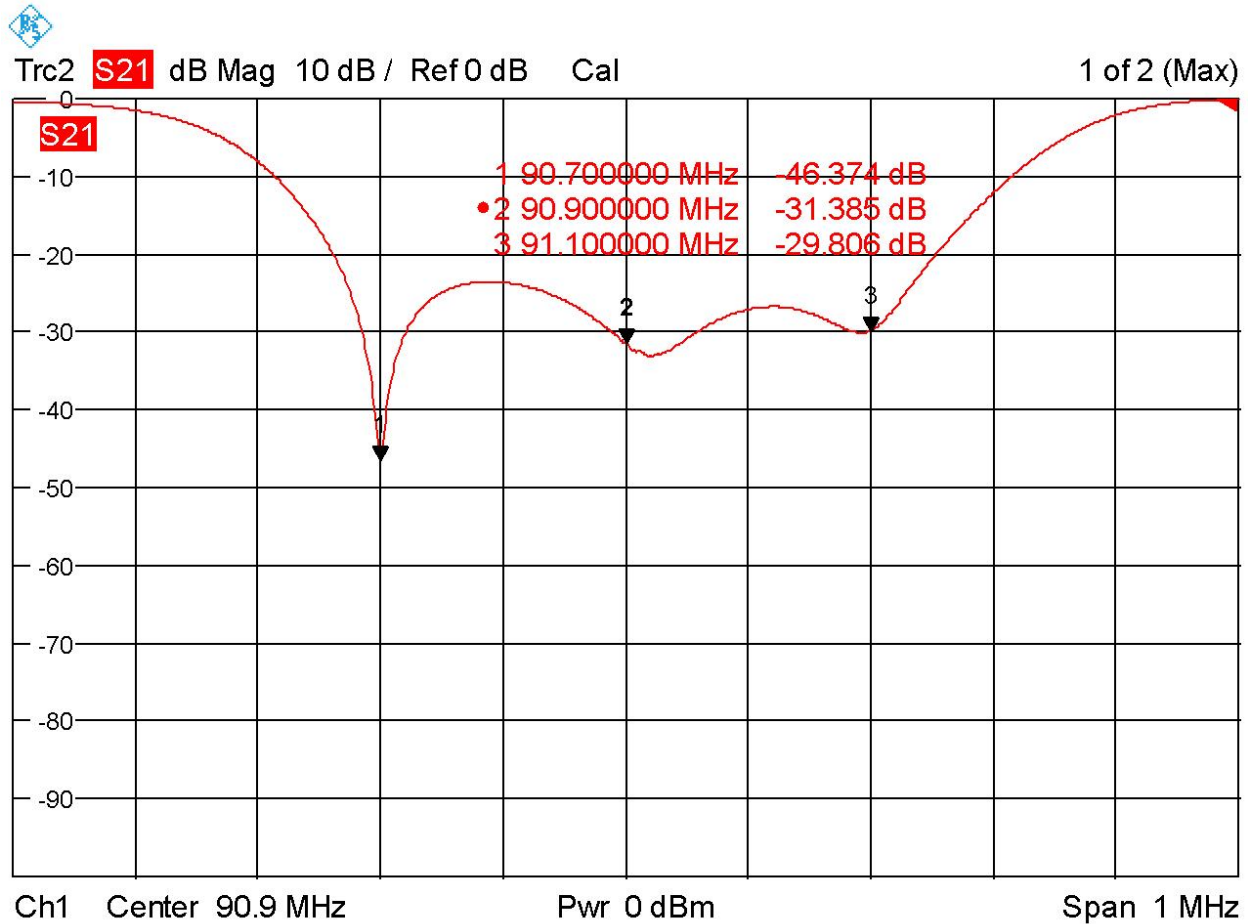


## Measurement 11: Final Broad Sweep of Antenna



Date: 2.DEC.2010 14:44:10

### Measurement 12: Filter to Antenna of 90.9 MHz.

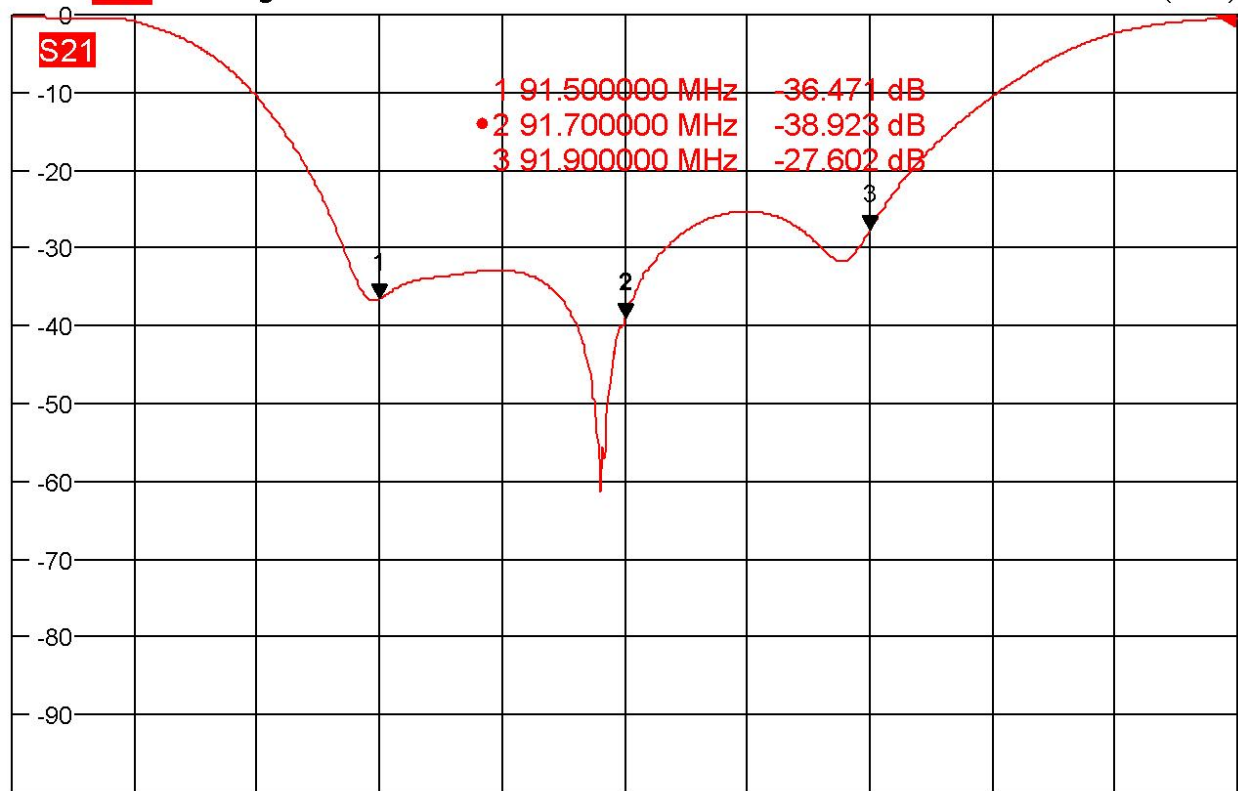


Date: 4.DEC.2010 16:38:34

### Measurement 13: Filter to Antenna of 91.7 MHz.



Trc2 **S21** dB Mag 10 dB / Ref 0 dB Cal 1 of 2 (Max)



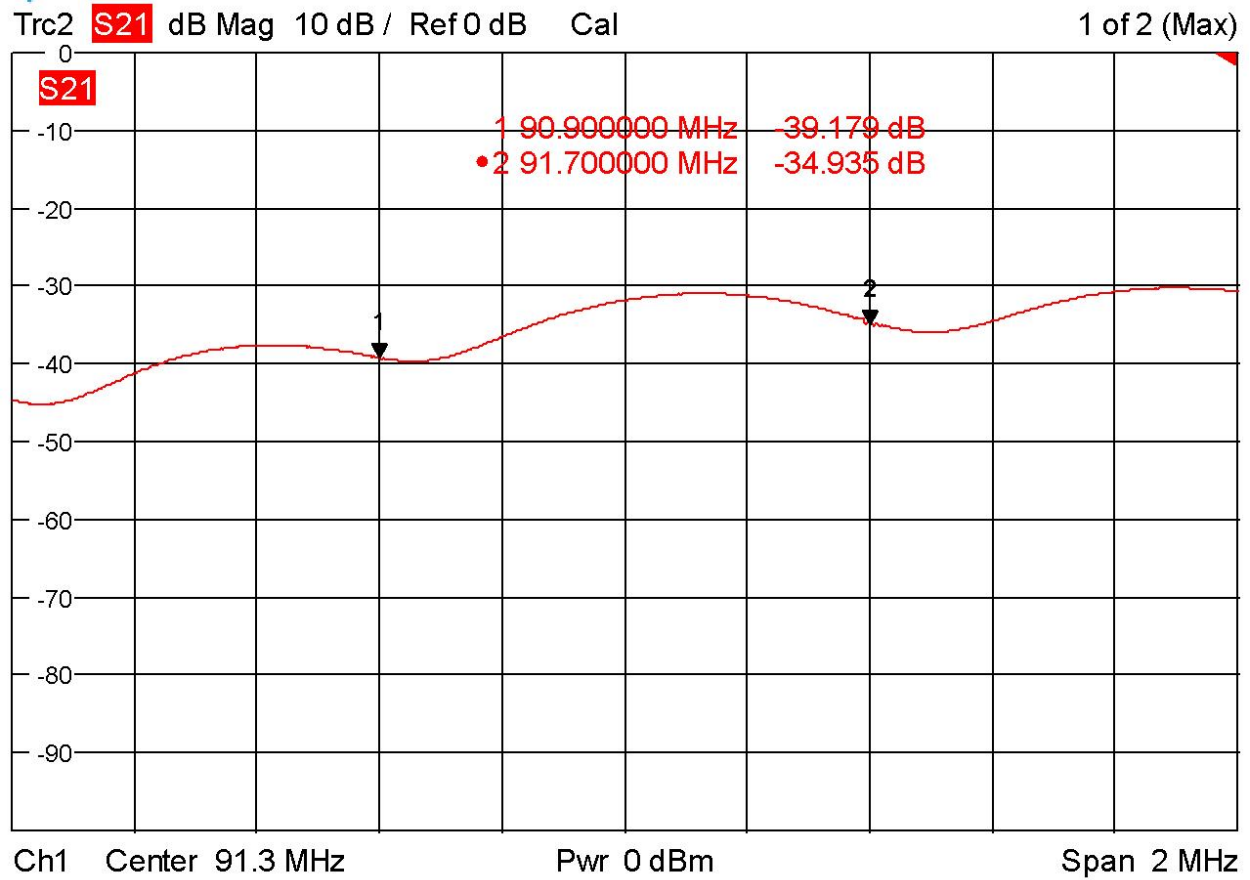
Ch1 Center 91.7 MHz

Pwr 0 dBm

Span 1 MHz

Date: 4.DEC.2010 17:00:10

**Measurement 14: 2 MHz Sweep of Feedline with 50 ohm Load at 90.9 and 91.7 MHz.**

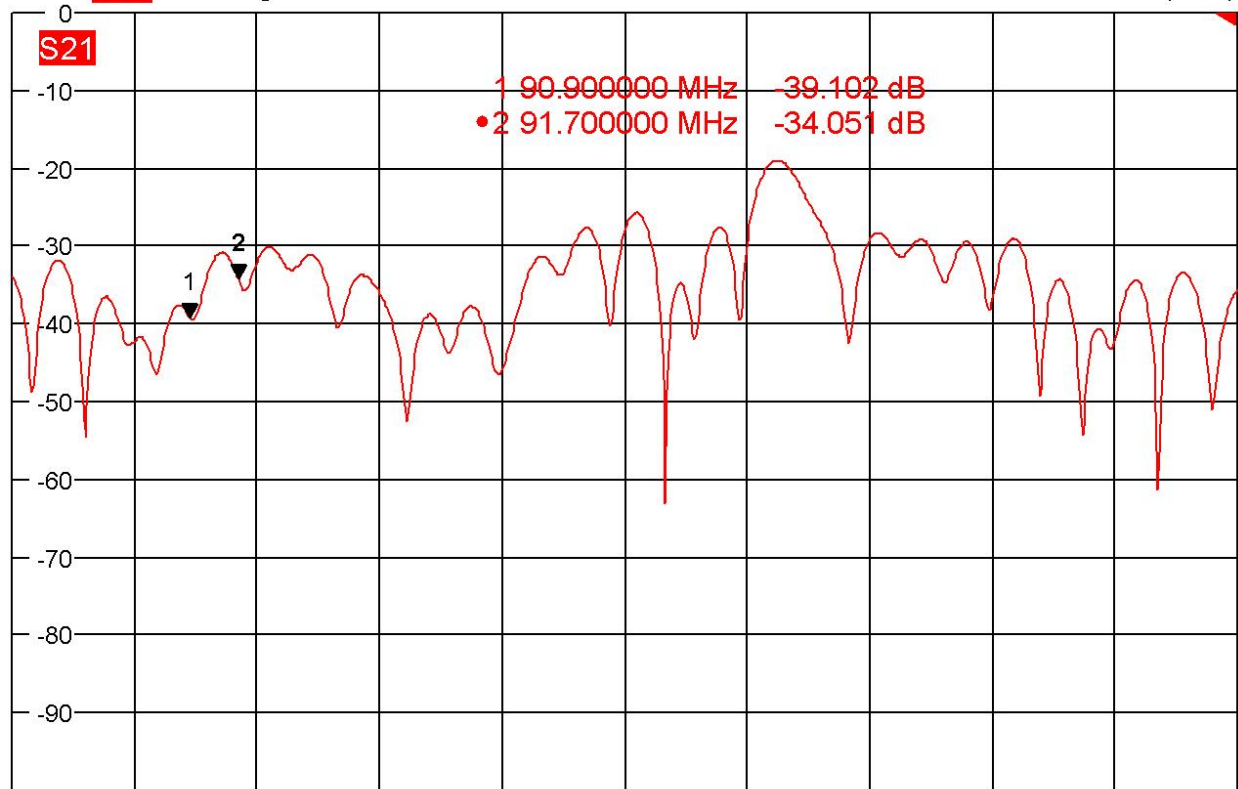


Date: 2.DEC.2010 12:31:52

### Measurement 15: 88 to 108 MHz. Sweep of Feedline with 50 ohm Load.



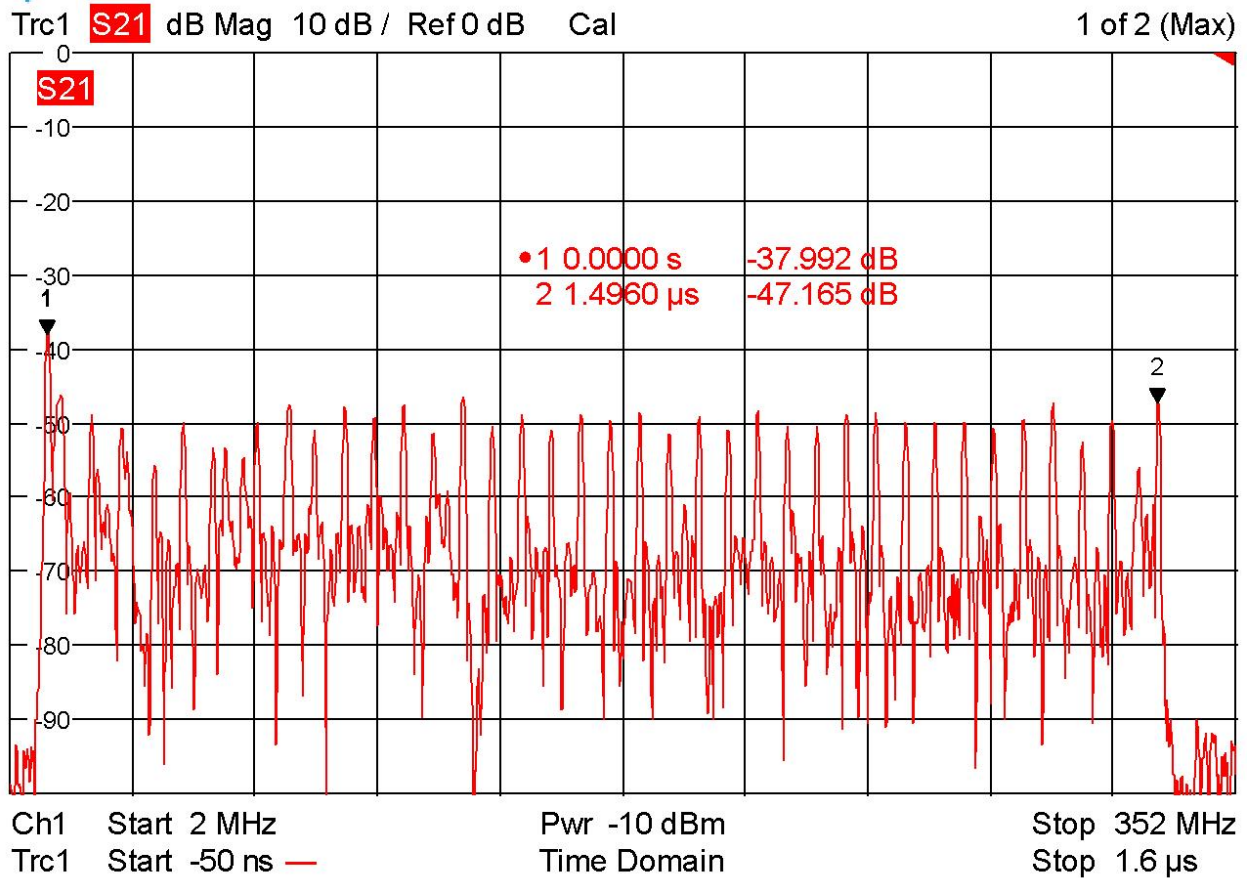
Trc2 **S21** dB Mag 10 dB / Ref 0 dB Cal 1 of 2 (Max)



Ch1 Center 98 MHz Pwr 0 dBm Span 20 MHz

Date: 2.DEC.2010 12:33:54

### Measurement 16: TDR of Feedline with 50 ohm Load 2-352 MHz.



Date: 2.DEC.2010 12:38:43

**Figure 4: 90.9 MHz. TPO Table**

<b>Station Call Sign</b>	<b>WGUC</b>
<b>Frequency (MHz)</b>	<b>90.9</b>
	<b>Analog</b>
	<b>Digital</b>
<b>ERP (W)</b>	<b>18500</b>
Antenna Model	SHPX-4AC-SP
Antenna Gain (multiplier)	2.136
<b>Antenna input power (W)</b>	<b>8661</b>
Main Horizontal and Vertical Line	3 1/8" Dielectric Rigid
Line Length (feet)	748
Line loss per hundred feet (dB/100')	-0.0924
Line loss total (dB)	-0.6910
Analog to Digital Isolation base of feedlines (dB)	0
Analog to Digital Isolation at Antenna Input (dB)	0.00
Analog to Digital Coupling Loss (dB)	0.0000
<b>Power Into Base of Vertical Line Run (W)</b>	<b>10155</b>
Coupled Power at Filter Output Ports (W)	0
Filter Insertion Loss (dB)	-0.257
<b>Power Input to Filter (W)</b>	<b>10774</b>
Circulator Insertion Loss (dB)	0
<b>Digital Power Input to Circulator</b>	<b>NA</b>
Rigid Feedline	
Line Length (feet)	
Line loss per hundred feet (dB/100')	0.000
Line loss total (dB)	0.0000
<b>TPO (W)</b>	<b>10774</b>

**Figure 5: 91.7 MHz. TPO Table**

<b>Station Call Sign</b>	<b>WVXU</b>	
<b>Frequency (MHz)</b>	<b>91.7</b>	
	<b>Analog</b>	<b>Digital</b>
<b>ERP (W)</b>	<b>26000</b>	
Antenna Model	SHPX-4AC-SP	
Antenna Gain (multiplier)	2.129	
<b>Antenna input power (W)</b>	<b>12212</b>	<b>0</b>
Main Horizontal and Vertical Line	3 1/8" Dielectric Rigid	
Line Length (feet)	748	
Line loss per hundred feet (dB/100')	-0.0928	0.0000
Line loss total (dB)	-0.6940	0.0000
Analog to Digital Isolation base of feedlines (dB)	0	
Analog to Digital Isolation at Antenna Input (dB)	0.00	
Analog to Digital Coupling Loss (dB)	0.0000	
<b>Power Into Base of Vertical Line Run (W)</b>	<b>14328</b>	
Coupled Power at Filter Output Ports (W)	0	0
Filter Insertion Loss (dB)	-0.245	0.000
<b>Power Input to Filter (W)</b>	<b>15160</b>	<b>0</b>
Circulator Insertion Loss (dB)	0	0
<b>Digital Power Input to Circulator</b>	<b>NA</b>	<b>0</b>
Rigid Feedline		
Line Length (feet)		
Line loss per hundred feet (dB/100')	0.000	
Line loss total (dB)	0.0000	0.000
<b>TPO (W)</b>	<b>15160</b>	<b>0</b>