

# **Field Service Report**

## **FM Combiner and Antenna System**

Fort Wayne, Indiana  
Main ERI Antenna SHPX-4AC-SP  
ERI 780-3 & 783-3 "TEE" Combiner  
Main Feedline: 3 1/8" ERI MACXLine and  
Cablewave Flexwell Air Cable 3 1/2"

Combiner System  
WMEE – 97.3 MHz.  
WQHK-FM – 105.1 MHz.

ERI Project # 28677

February 27, 2012

### **Submitted By:**

Jeff Taylor  
7777 Gardner Rd.  
Chandler, In. 47610  
TX: 812-926-6000 Ext. 276  
Cell: 812-459-6544  
EM: JTaylor@eriinc.com



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## **INTRODUCTION**

Listed below is a summary of the data and attached are the plots collected from the WMEE ~ WQHK-FM transmission site in Fort Wayne, Indiana. by Jeff Taylor February 27, 2012.

- The main antenna is a SHPX-4AC-SP.
- The combiner is a 780-3 & 783-3 "TEE" Combiner with rack mounted.
- 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 antenna were taken at the output of the 3 1/8" flex connector.
- All measurements of the combiner were taken at the input and output of the combiner without directional couplers.

The reason for this Field Service Trip was to tune the main antenna and proof the combiner system. All physical connections of the combiner were inspected to ensure solid electrical connections were made.

## **SUMMARY and RECOMMENDATIONS**

All measurements were taken by Jeff Taylor of Electronics Research Inc. February, 2012.

Sincerely

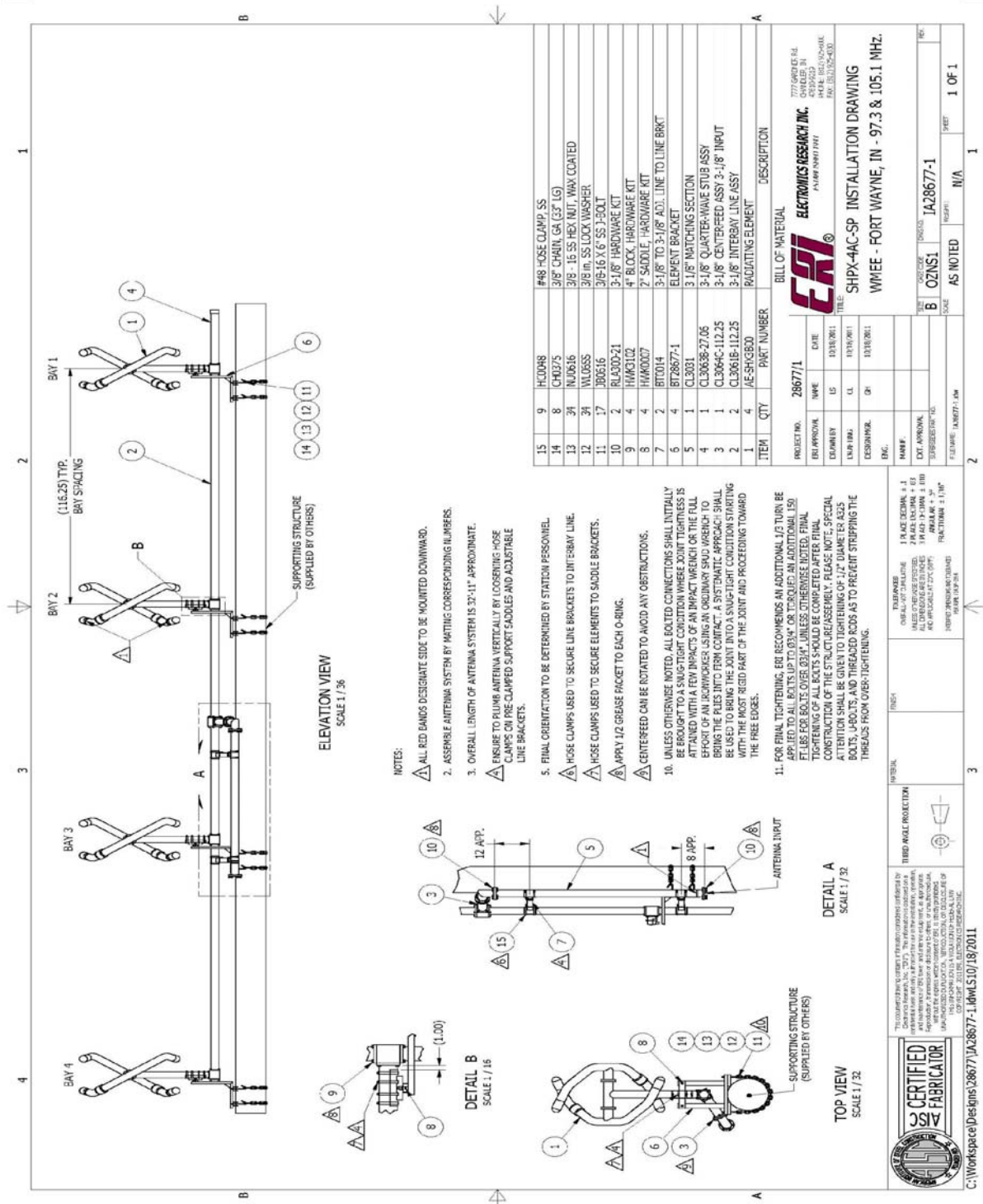
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Jeff Taylor

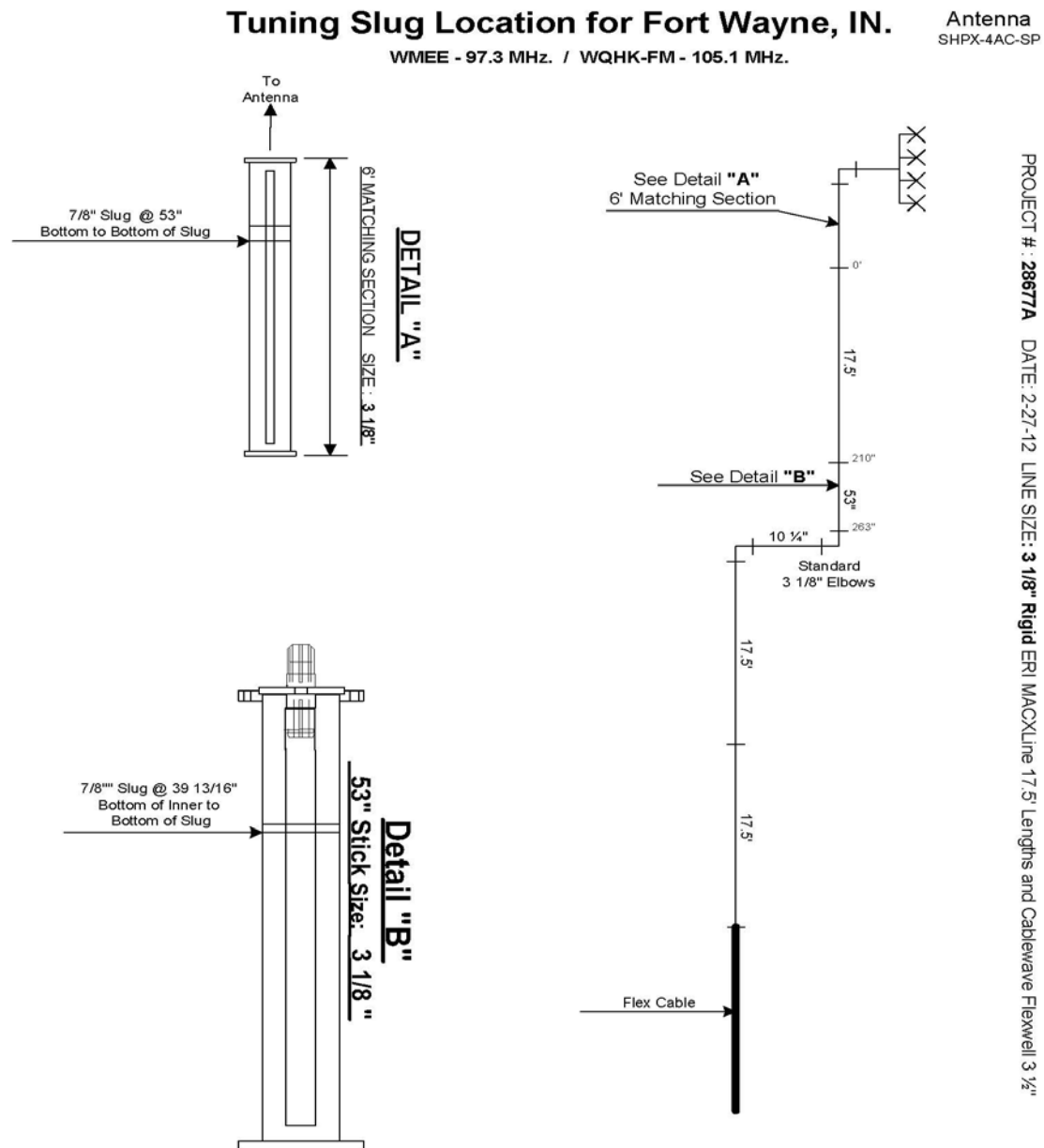
### Figure 1: Combiner Drawing



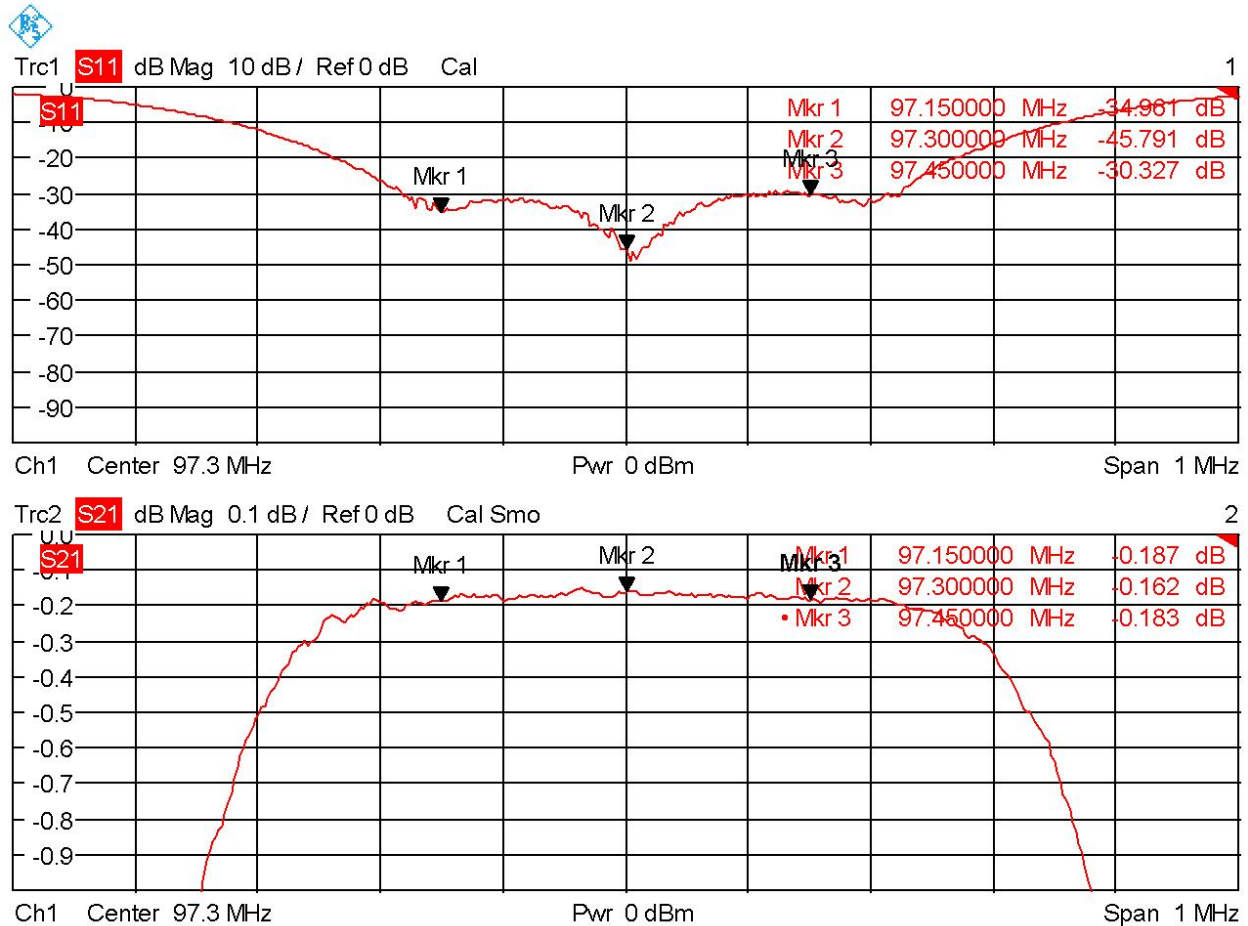
### Figure 2: Main Antenna Drawing



**Figure 3: Feedline Tuning Slug Location**

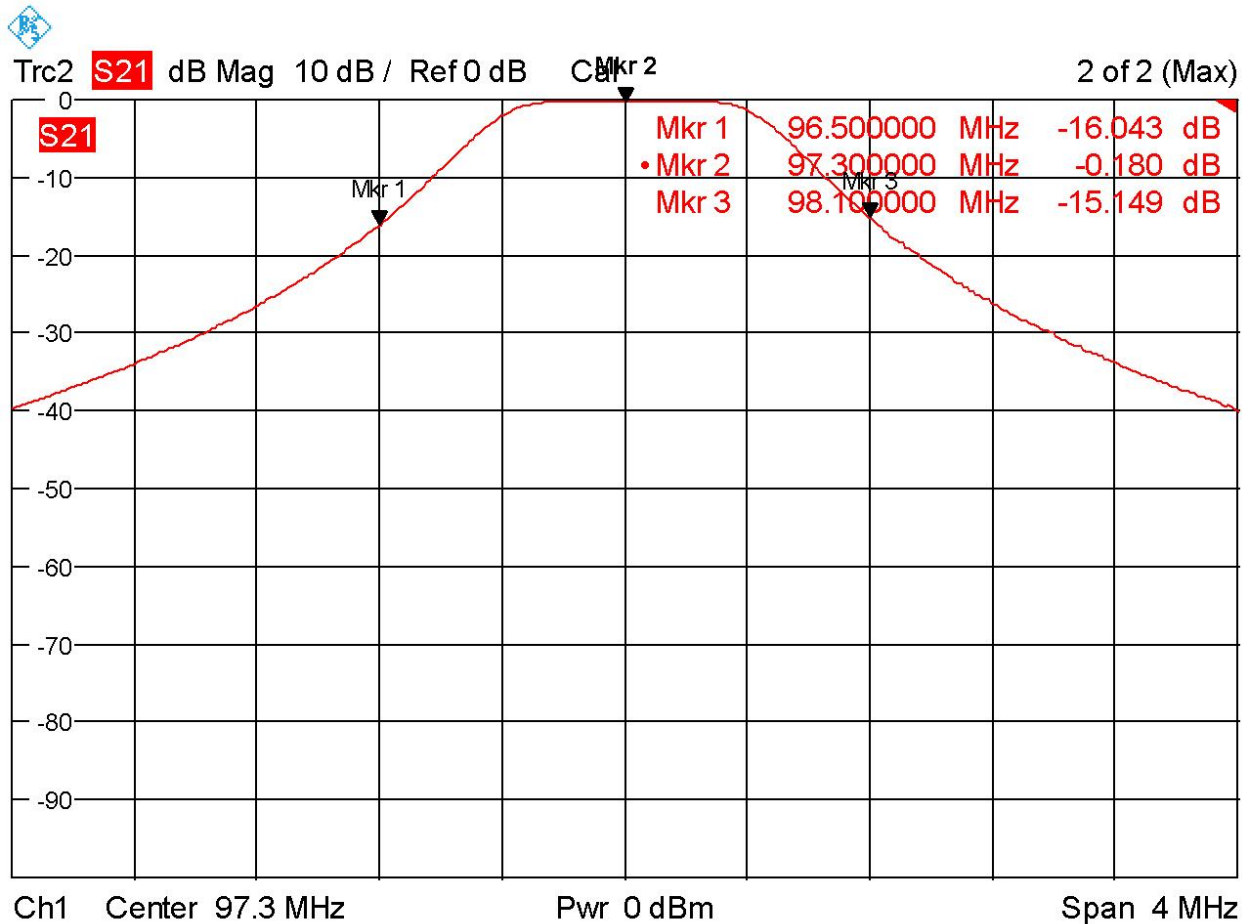


## Measurement 1: Match and Insertion Loss of 97.3 MHz.



Date: 27.FEB.2012 17:49:02

**Measurement 2: Isolation +/- 800 KHz. of 97.3 MHz.**



Date: 27.FEB.2012 17:50:56

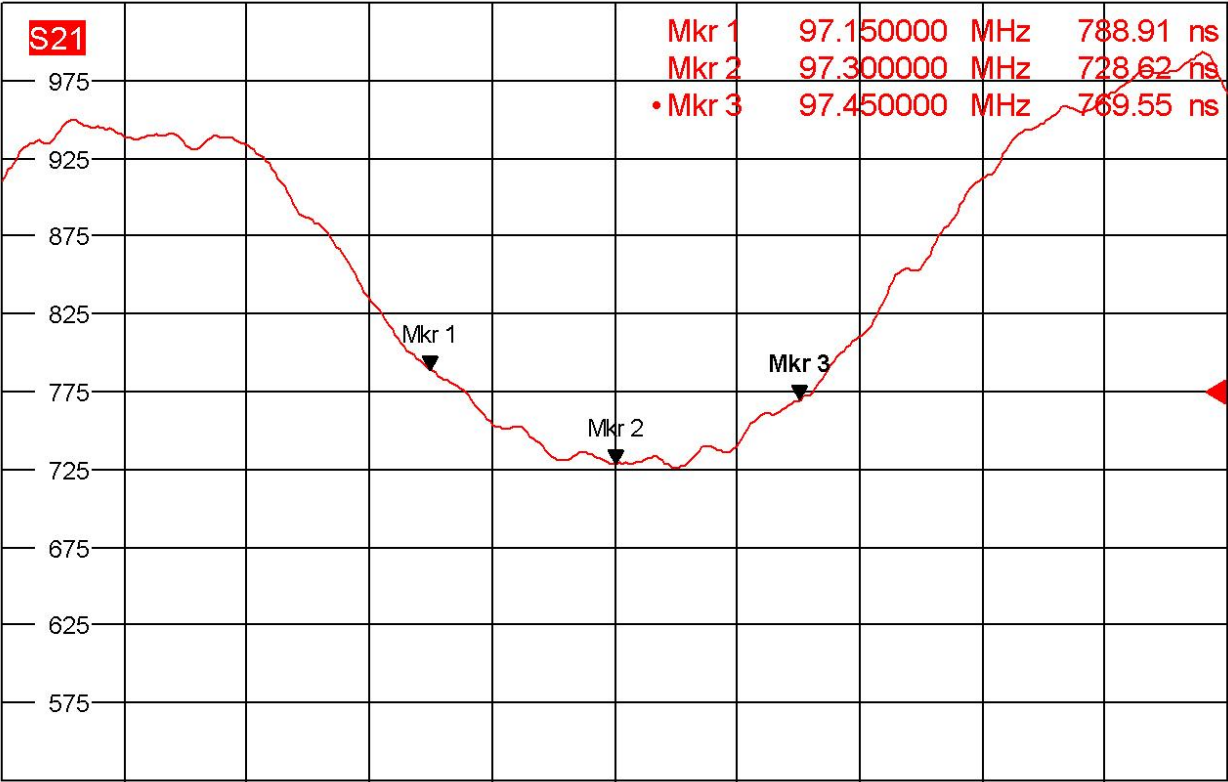


**Measurement 3: Group Delay of 97.3 MHz.**



Trc2 **S21** Delay 50 ns/ Ref 775 ns Cal Smo

2 of 2 (Max)



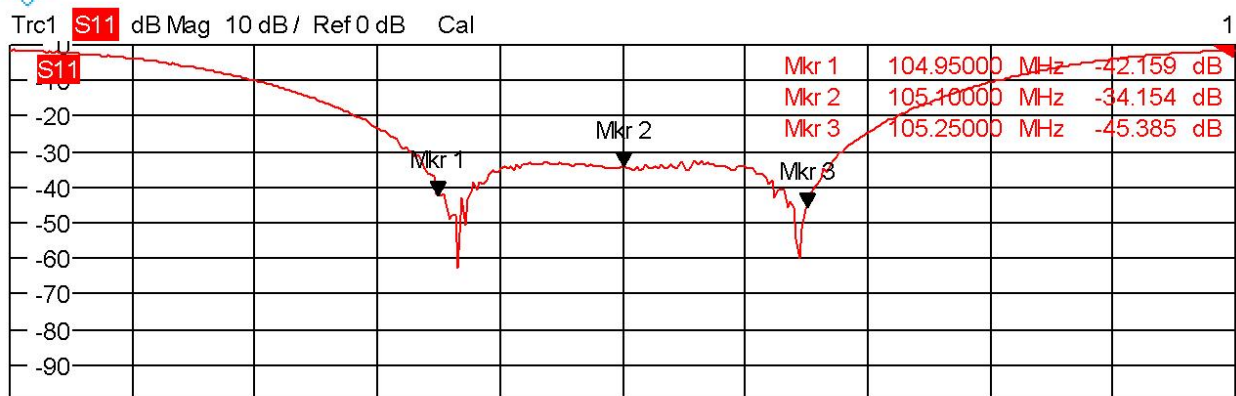
Ch1 Center 97.3 MHz

Pwr 0 dBm

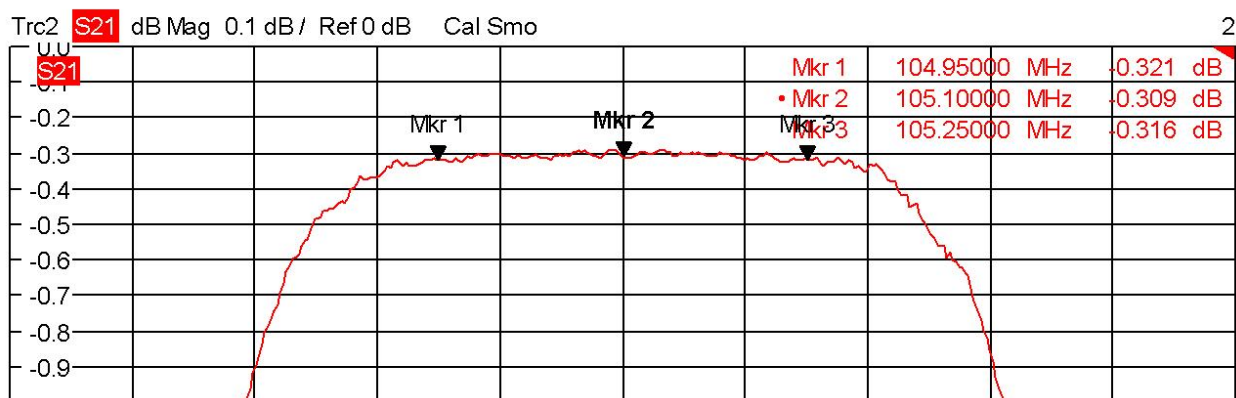
Span 1 MHz

Date: 27.FEB.2012 17:50:10

## Measurement 4: Match and Insertion Loss of 105.1 MHz.



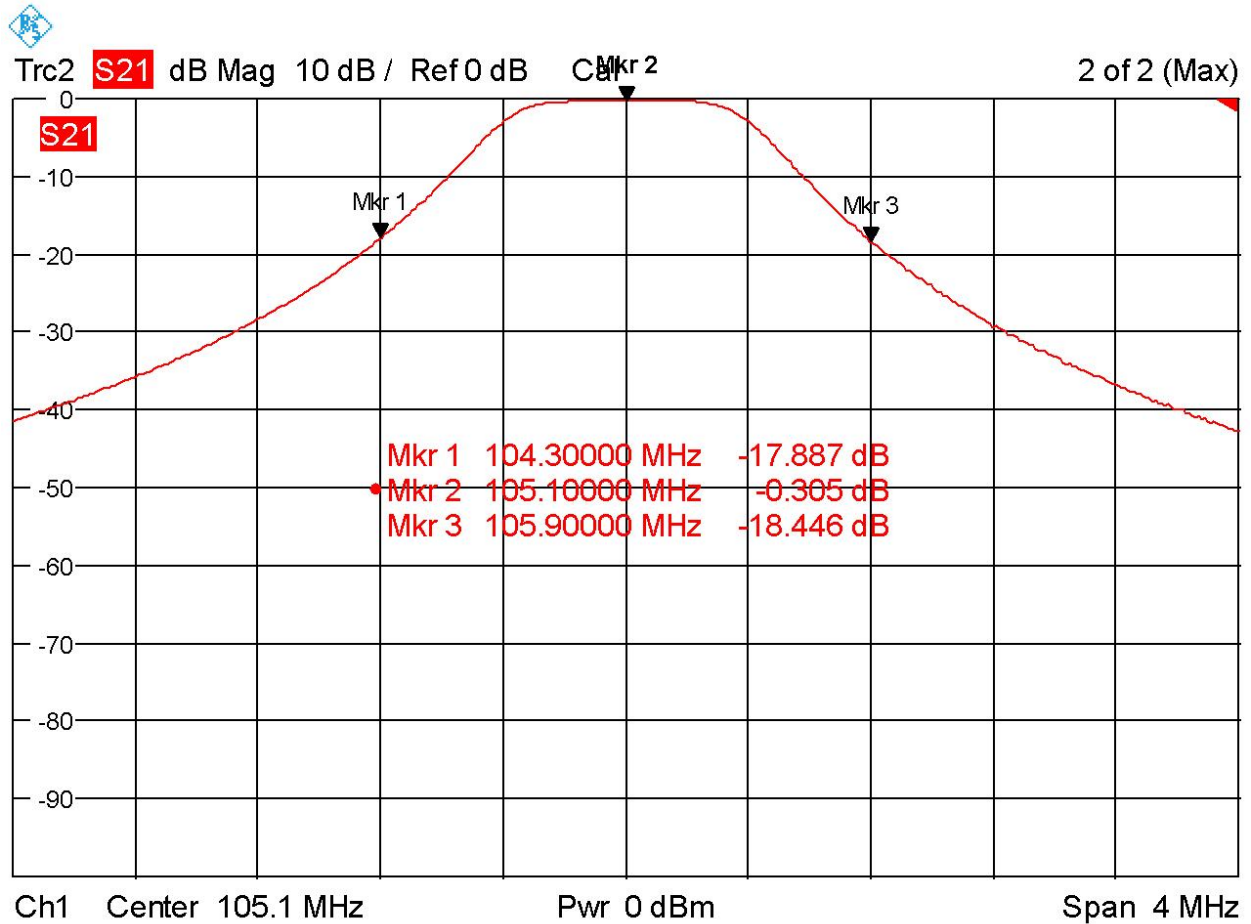
Ch1 Center 105.1 MHz Pwr 0 dBm Span 1 MHz



Ch1 Center 105.1 MHz Pwr 0 dBm Span 1 MHz

Date: 27.FEB.2012 17:44:43

### Measurement 5: Isolation +/- 800 KHz. of 105.1 MHz.



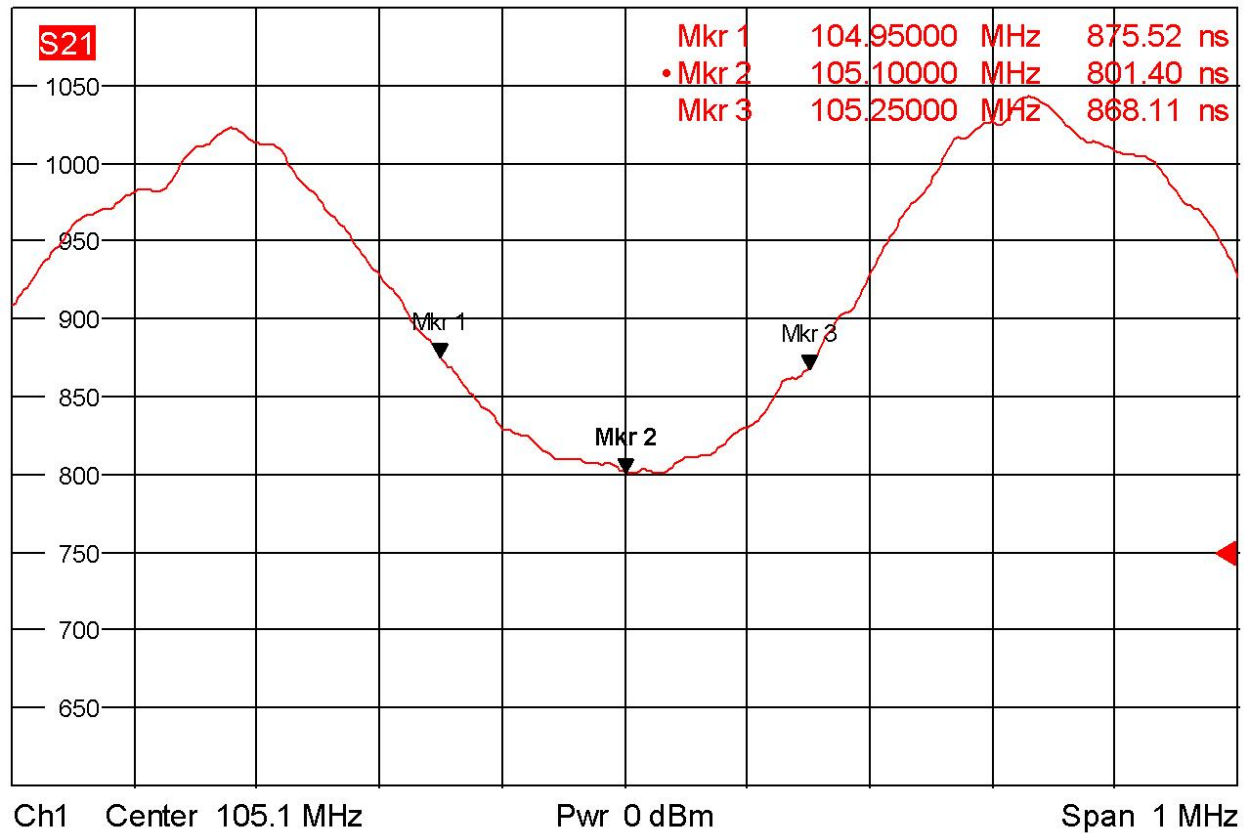
Date: 27.FEB.2012 17:45:36

### Measurement 6: Group Delay of 105.1 MHz.



Trc2 **S21** Delay 50 ns/ Ref 750 ns Cal Smo

2 of 2 (Max)

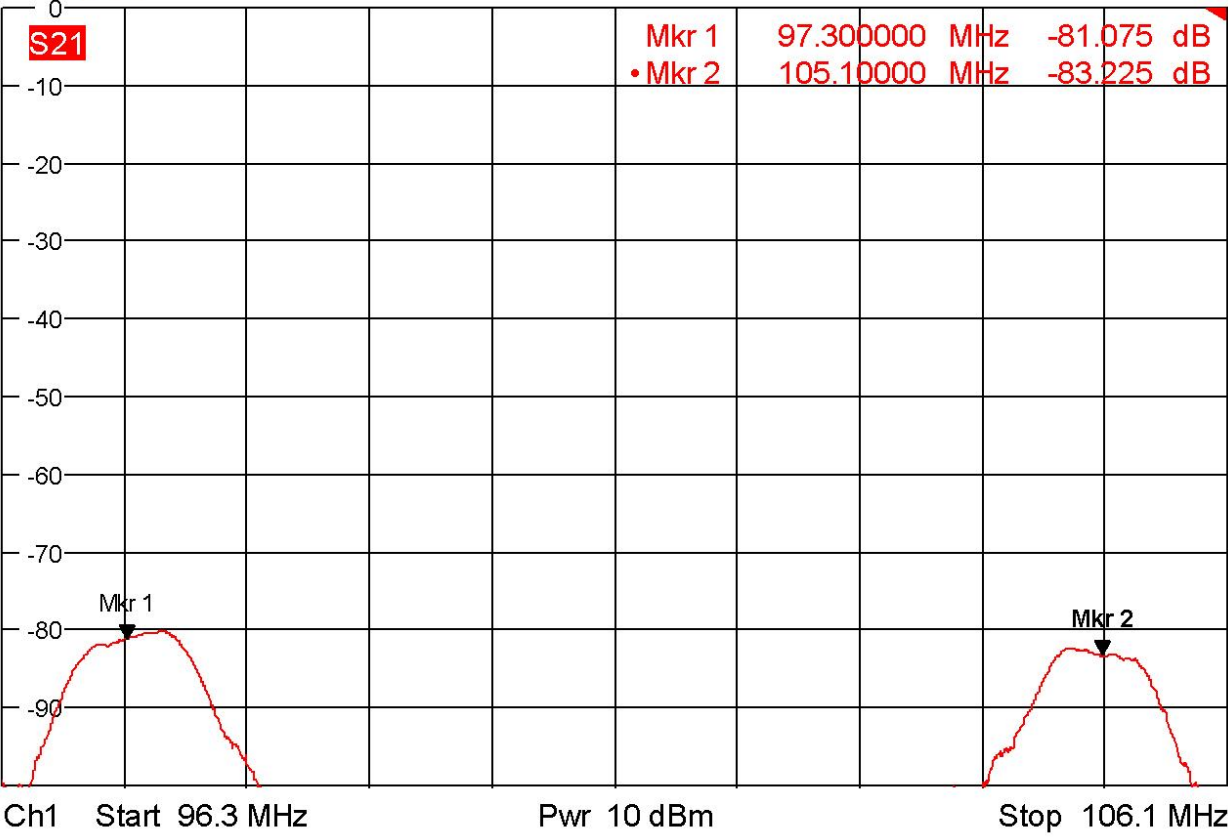


Date: 27.FEB.2012 17:47:02

**Measurement 7: Port to Port Isolation from 97.3 to 105.1 MHz.**



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

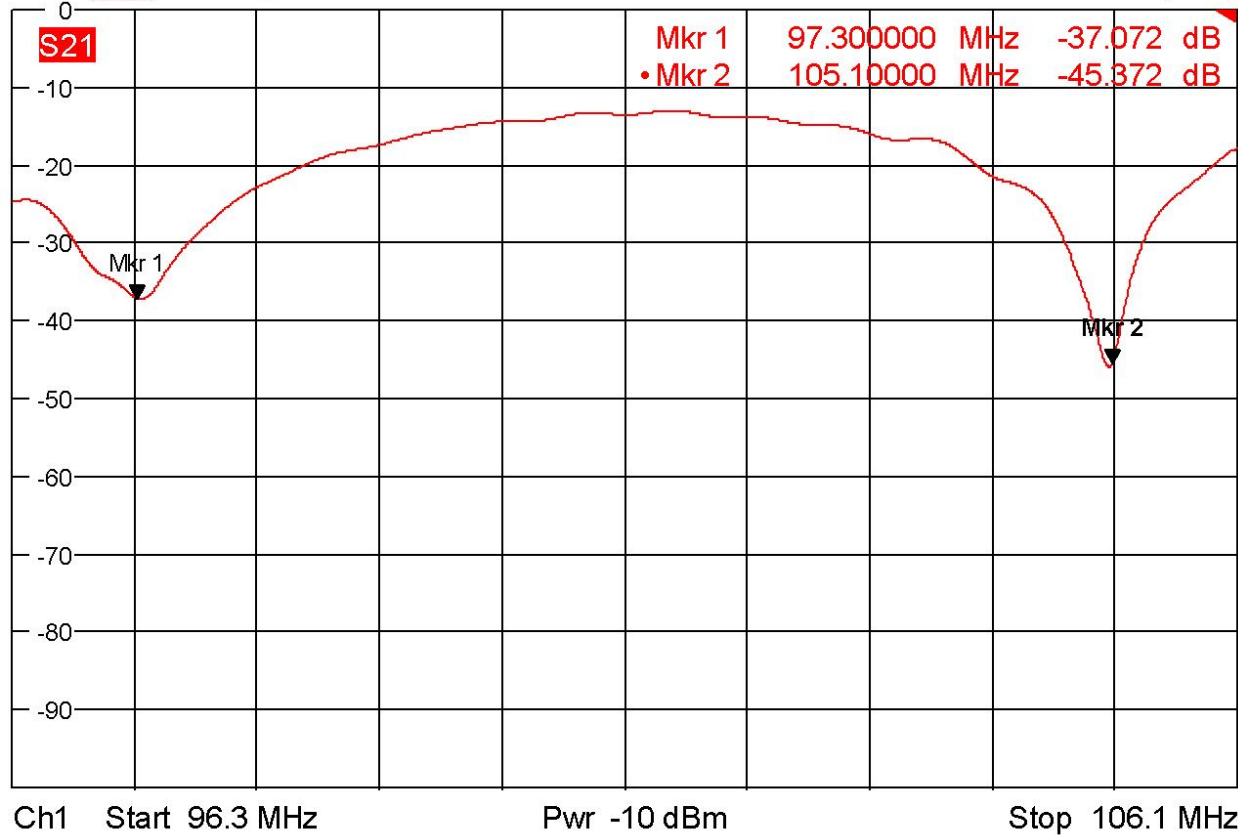


Date: 27.FEB.2012 17:53:49

### Measurement 8: Final Broad Sweep of Main Ant for 97.3 and 105.1 MHz.

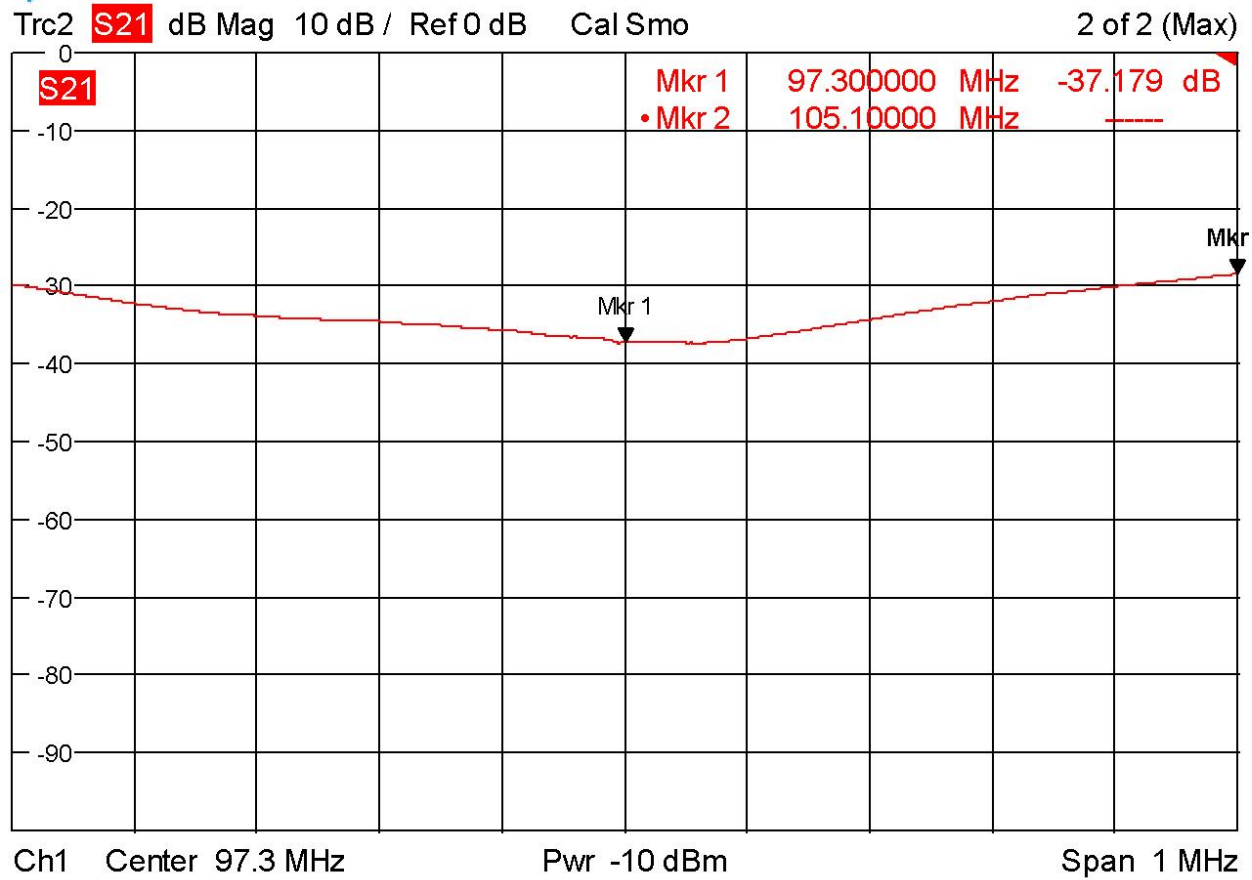


Trc2 **S21** dB Mag 10 dB / Ref 0 dB Cal Smo 2 of 2 (Max)



Date: 27.FEB.2012 16:45:49

### Measurement 9: 1 MHz. Sweep of Final Antenna 97.3 MHz.

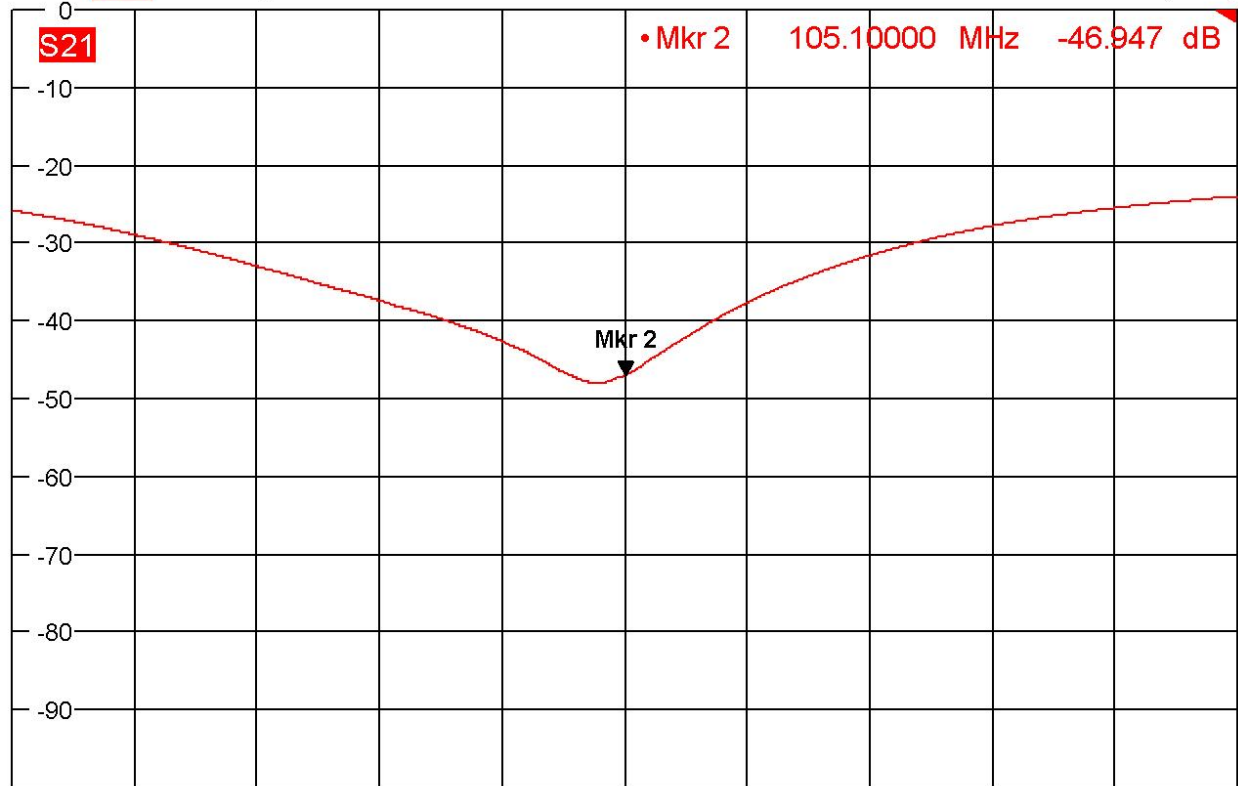


Date: 27.FEB.2012 16:47:49

**Measurement 10: 1 MHz. Sweep of Final Antenna 105.1 MHz.**



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



Ch1 Center 105.1 MHz Pwr -10 dBm Span 1 MHz

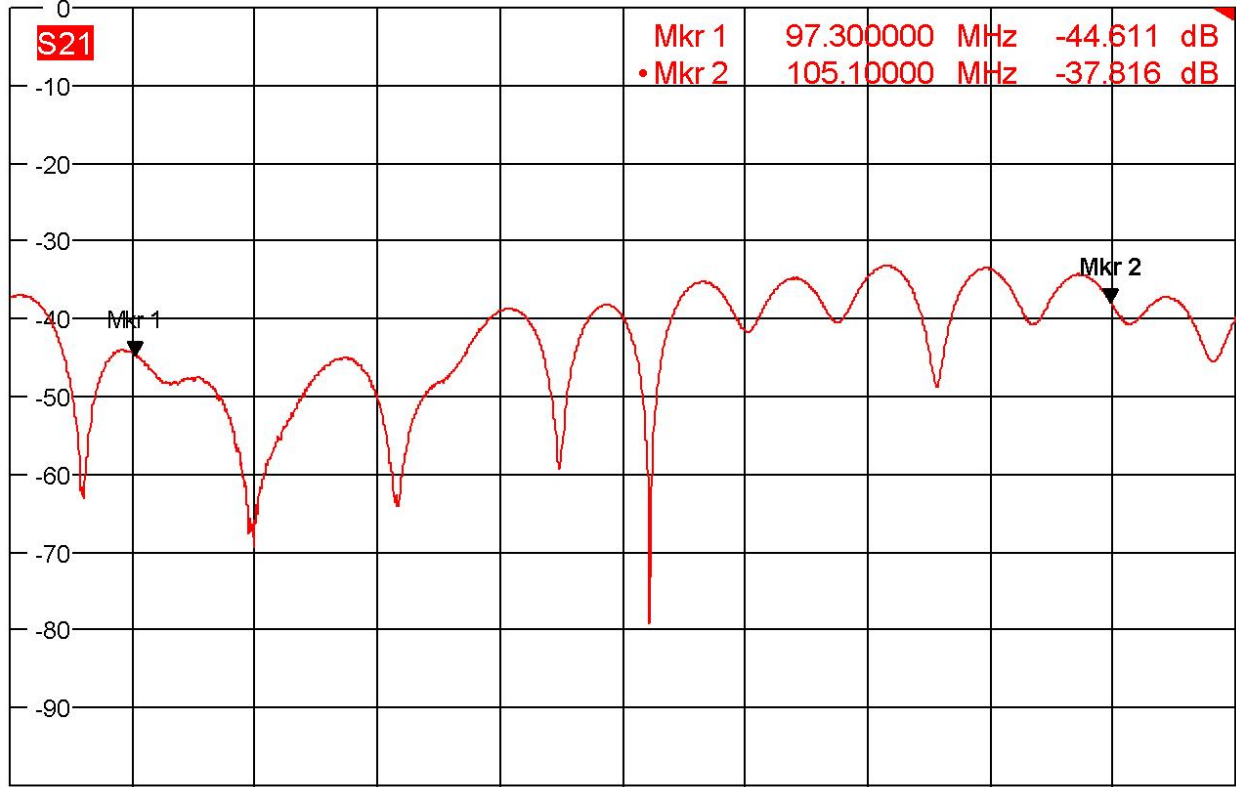
Date: 27.FEB.2012 16:50:07



### Measurement 11: Narrow Sweep of Feedline with 50 ohm Load.



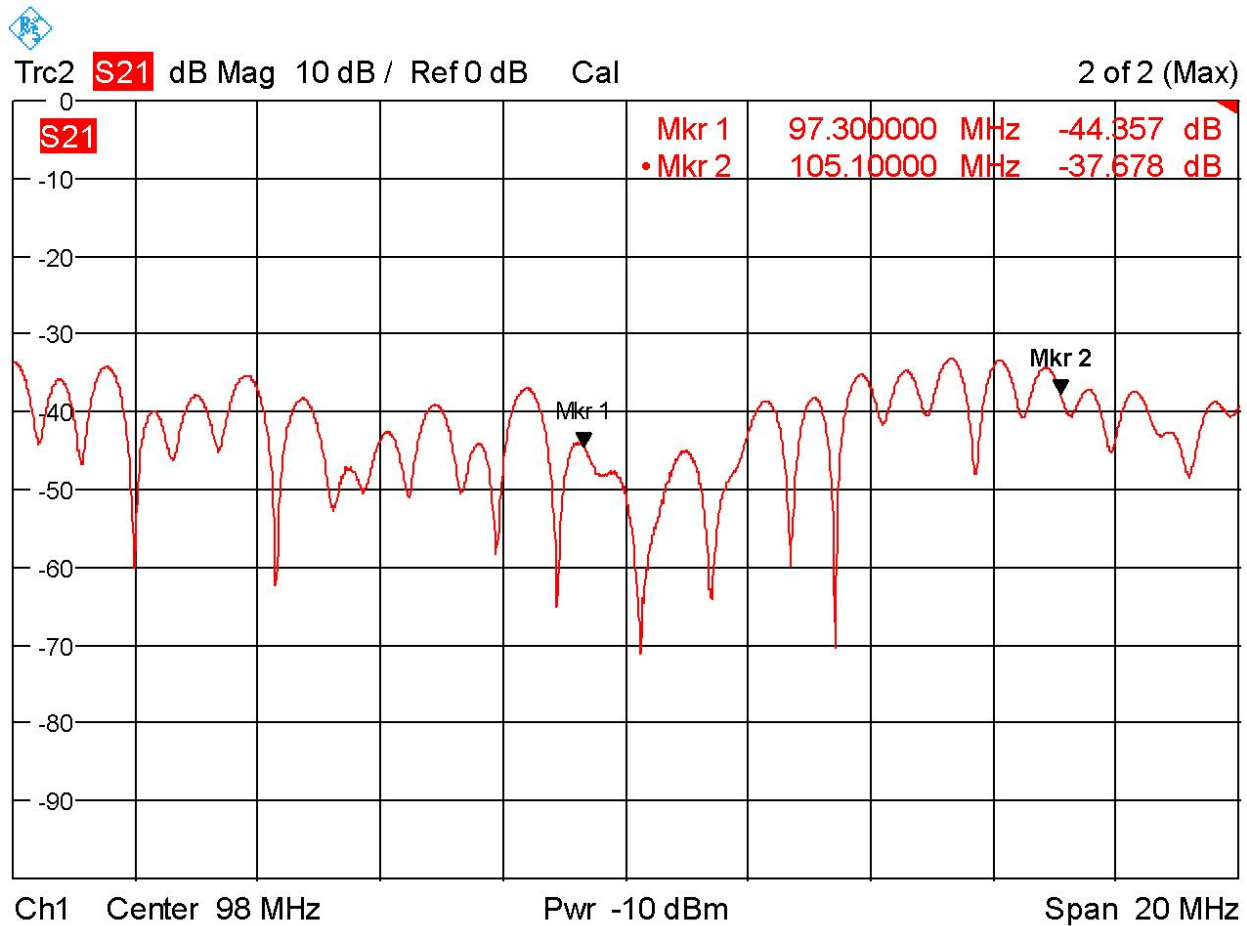
Trc2 **S21** dB Mag 10 dB / Ref 0 dB Cal 2 of 2 (Max)



Ch1 Start 96.3 MHz Pwr -10 dBm Stop 106.1 MHz

Date: 27.FEB.2012 11:00:50

**Measurement 12: 20 MHz. Sweep of Feedline with 50 ohm Load 88 to 108 MHz.**



Date: 27.FEB.2012 11:02:57

### Measurement 13: TDR of Feedline with 50 ohm Load 2 to 352 MHz.

Mkr#1 is Test Adapter @ 0'.

Mkr#2 is Elbow @ Base of Tower Approx 21'.

Mkr#3 is End of Flex Feedline Run @ Approx 614'.

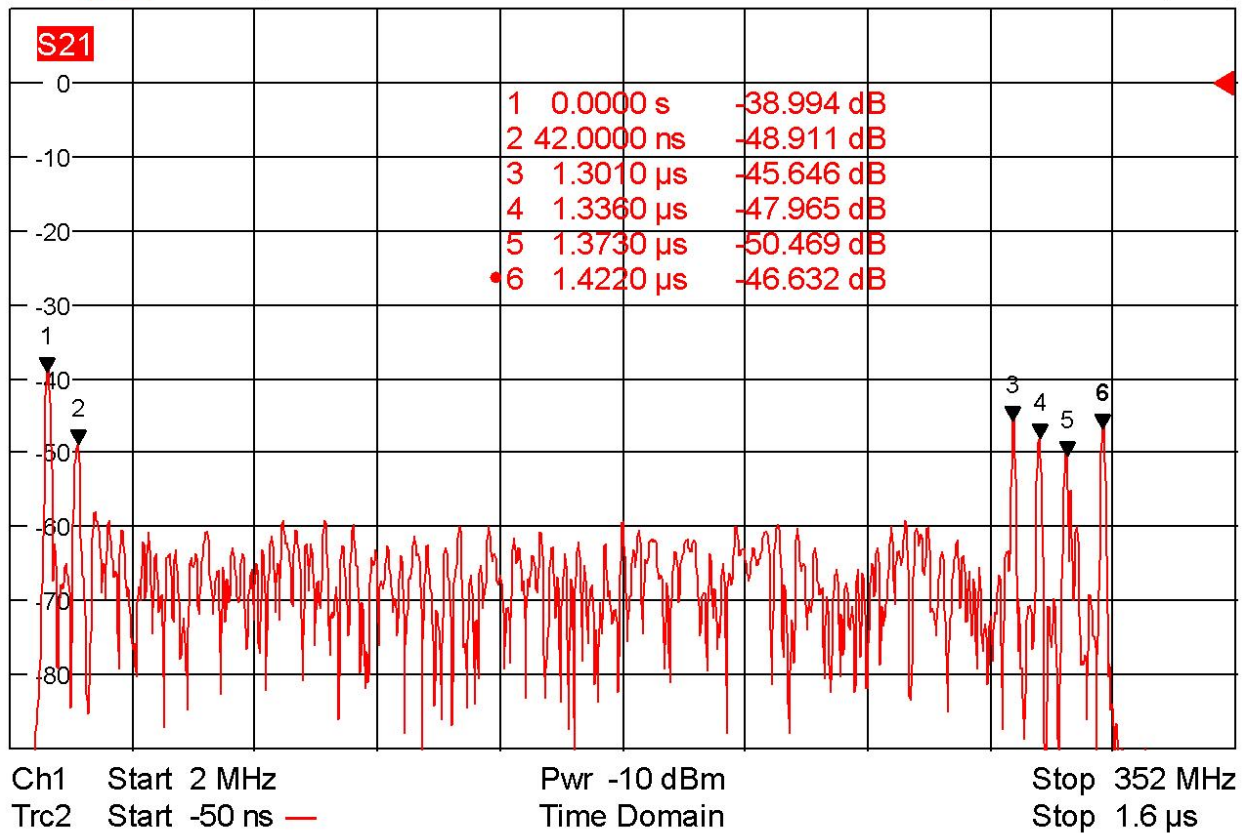
Mkr#4 & 5 is are Bullet Connections of the Bottom (2) 17.5' Sticks.

Mkr#6 is End of Feedline Run @ Approx 674'.



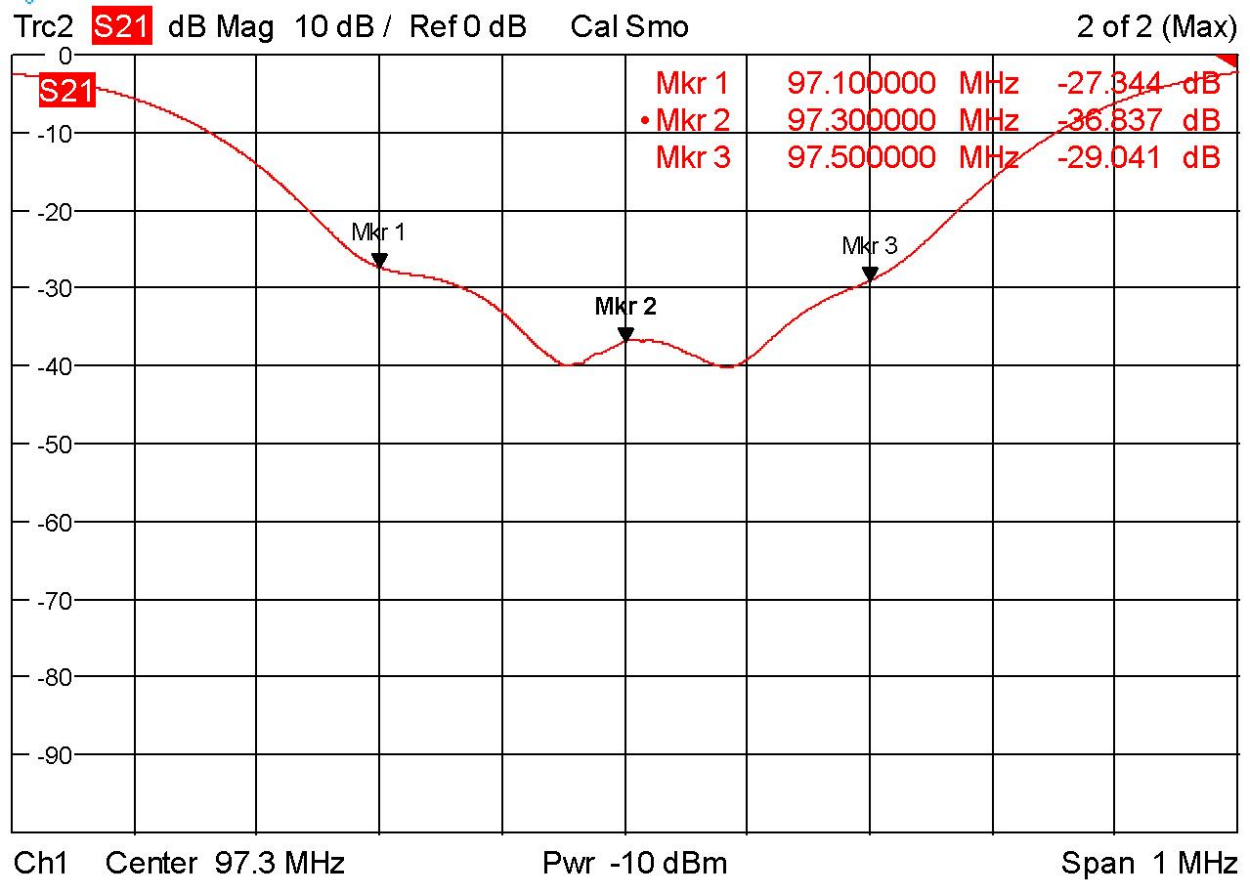
Trc2 **S21** dB Mag 10 dB / Ref 0 dB Cal

2 of 2 (Max)



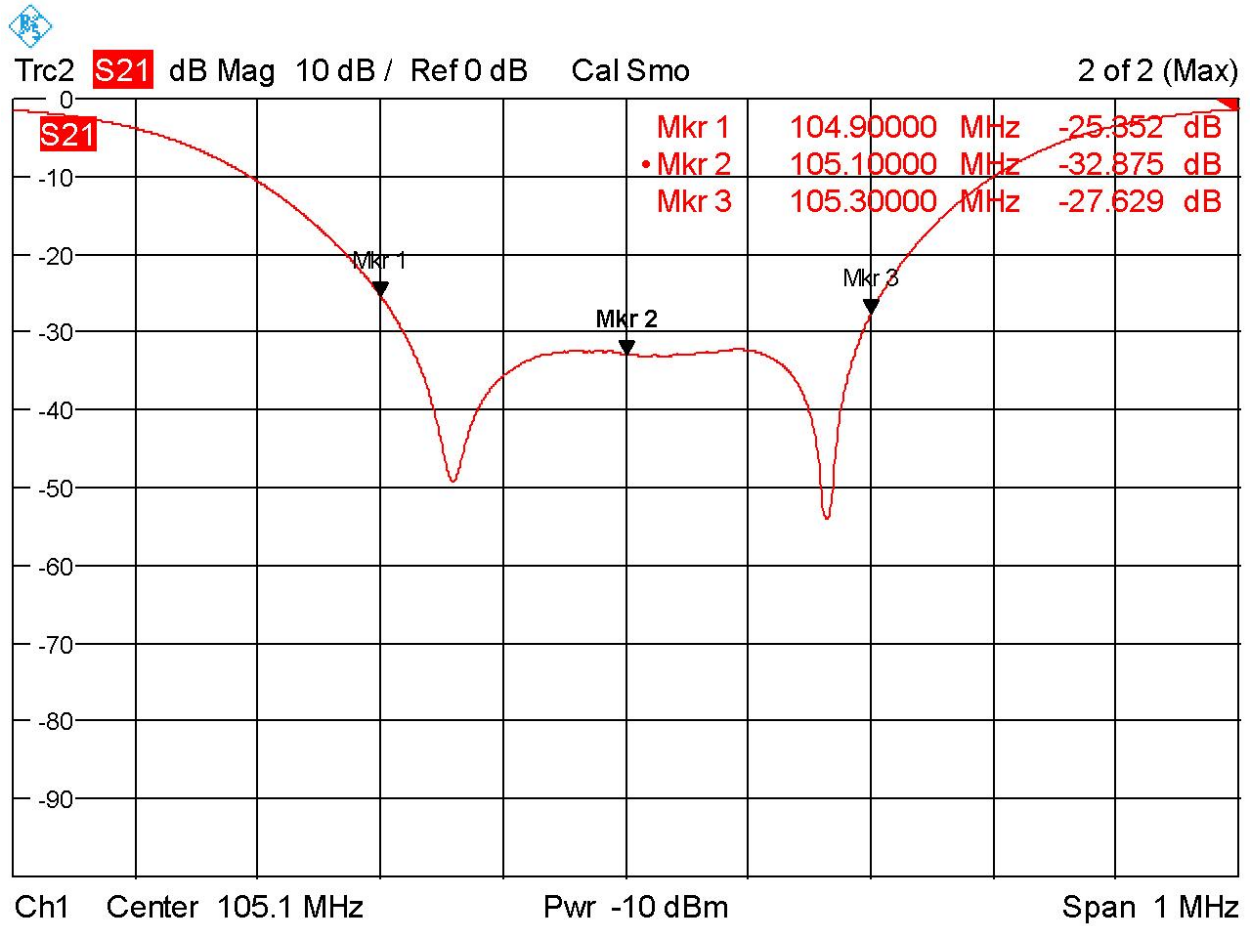
Date: 27.FEB.2012 11:08:55

### Measurement 14: Filter to Antenna of 97.3 MHz.



Date: 28.FEB.2012 09:19:00

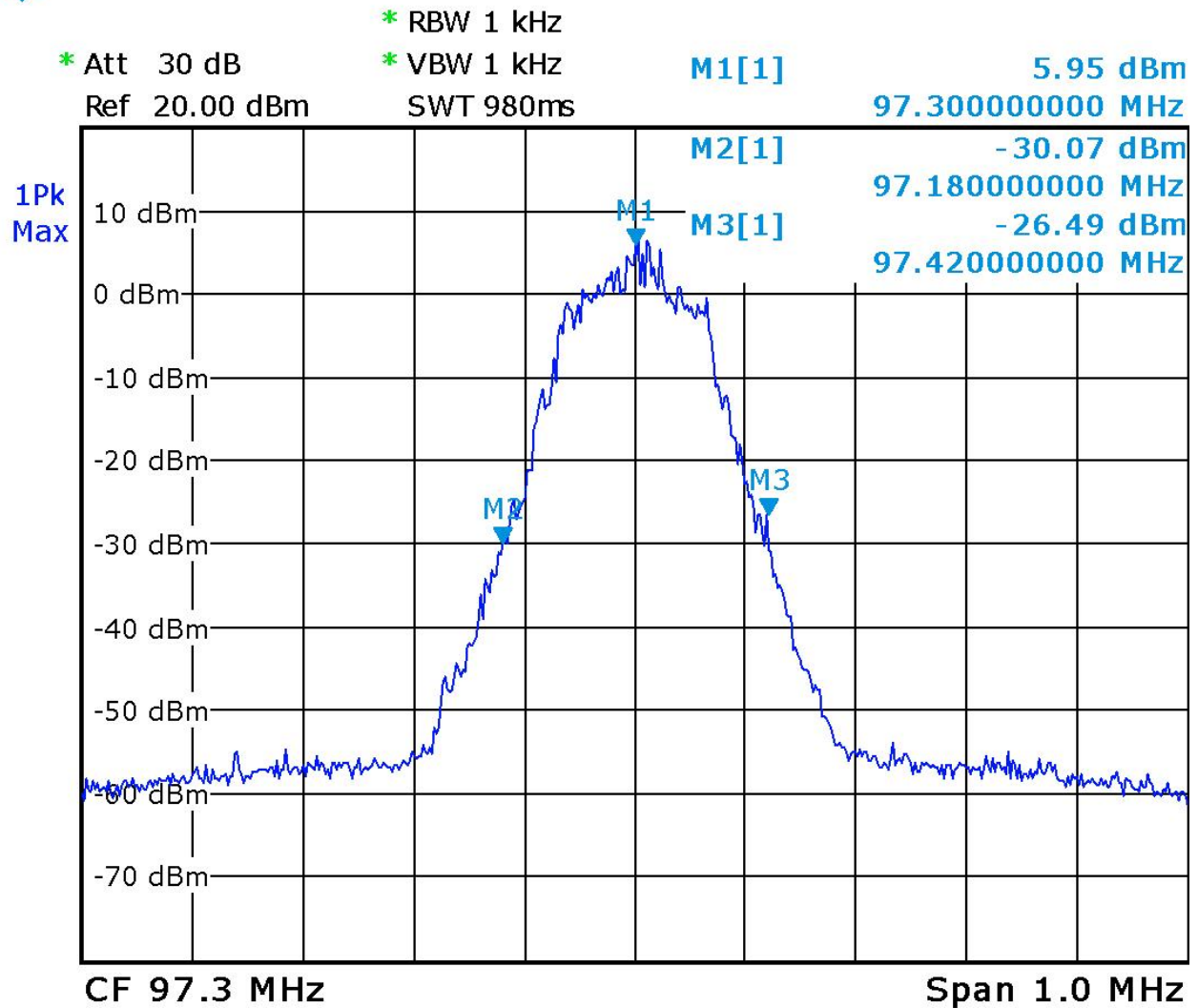
### Measurement 15: Filter to Antenna of 105.1 MHz.



Date: 28.FEB.2012 09:27:10

# Measurement 16: Occupied Bandwidth Measurement of 97.3 MHz.

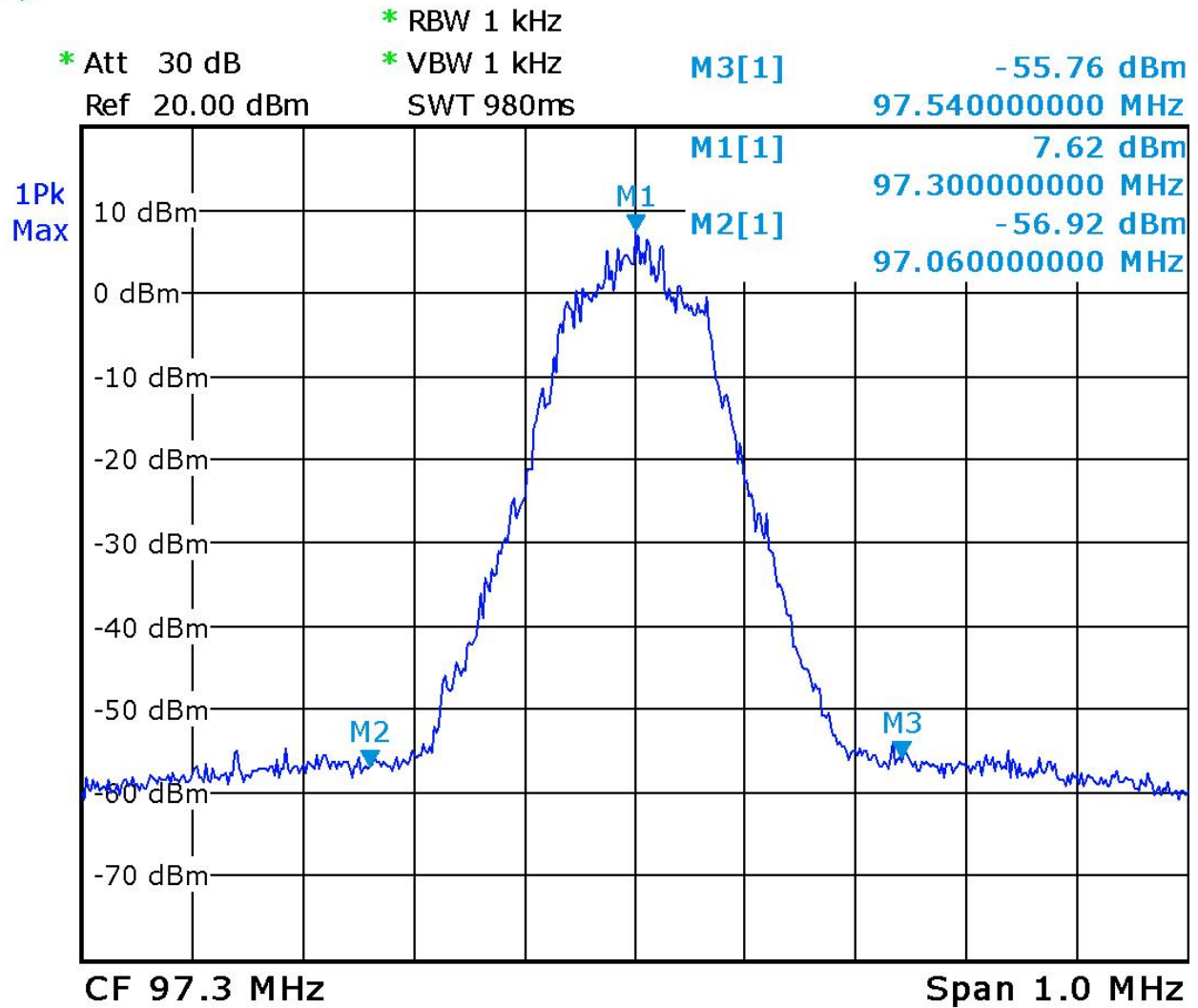
Mkr's +/- 120 KHz. of Carrier.



Date: 28.FEB.2012 15:31:45

# Measurement 17: Occupied Bandwidth Measurement of 97.3 MHz.

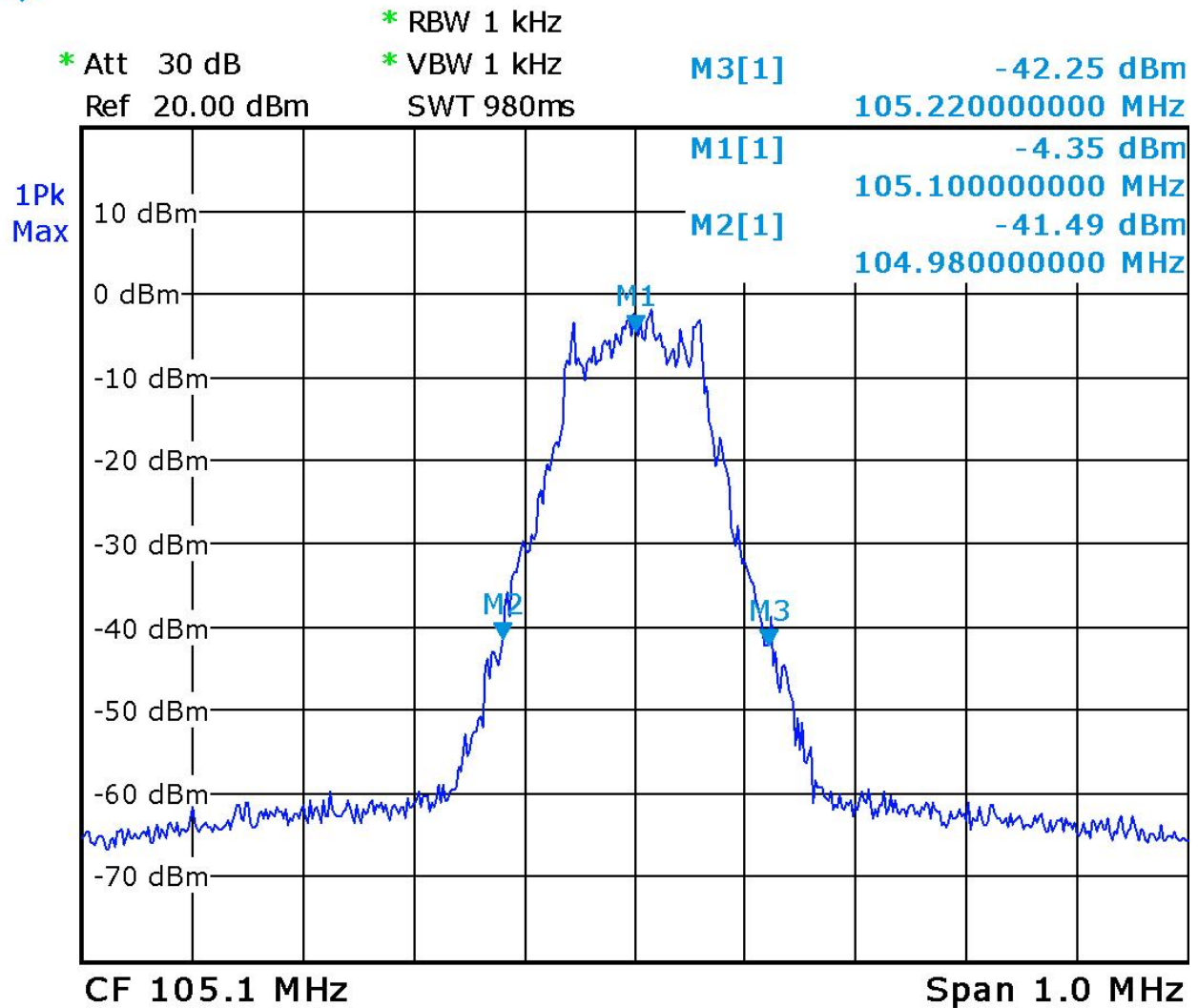
Mkr's +/- 240 KHz. of Carrier.



Date: 28.FEB.2012 15:32:50

## Measurement 18: Occupied Bandwidth Measurement of 105.1 MHz.

Mkr's +/- 120 KHz. of Carrier.

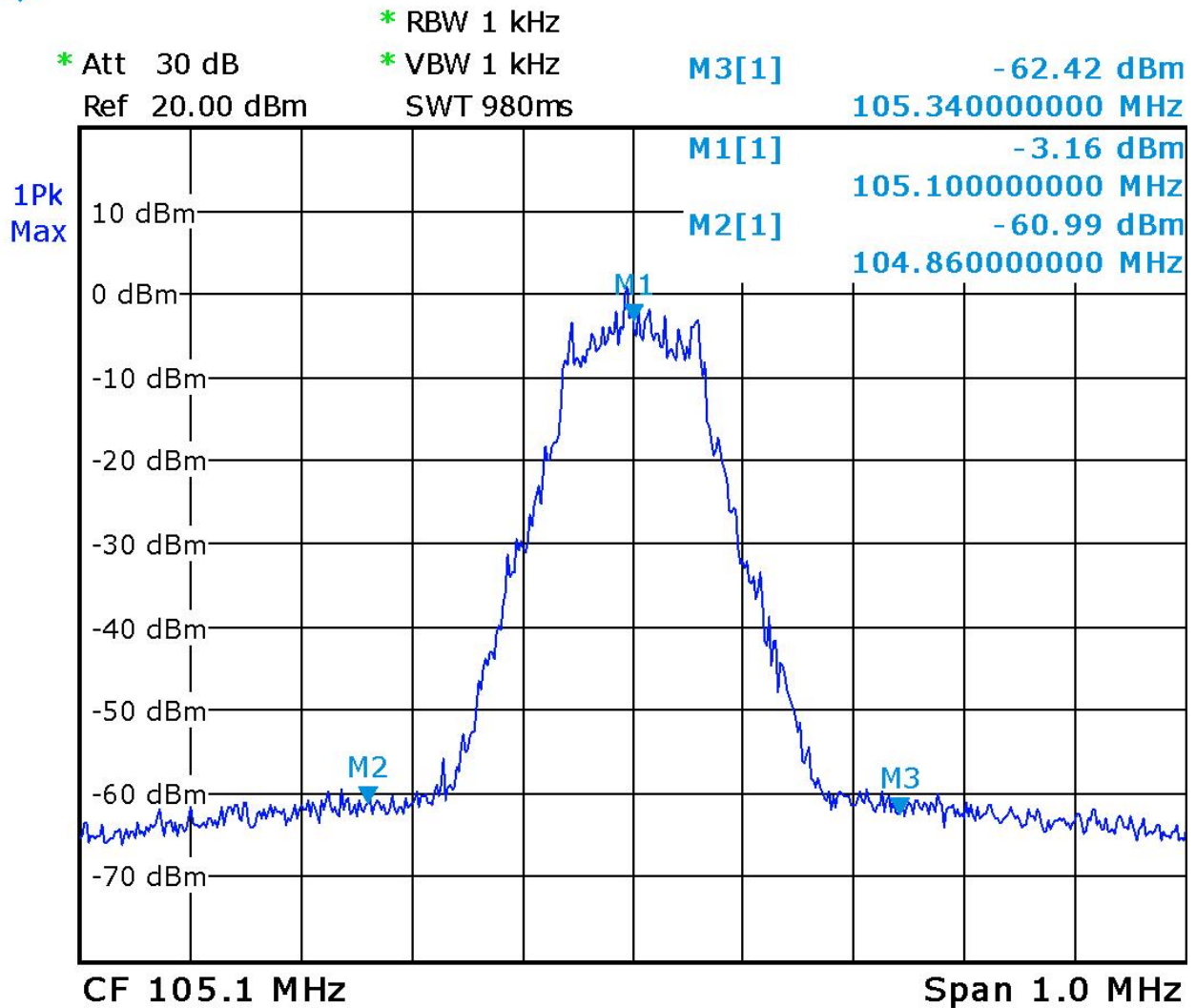


Date: 28.FEB.2012 15:45:08



# Measurement 19: Occupied Bandwidth Measurement of 105.1 MHz.

Mkr's +/- 240 KHz. of Carrier.



Date: 28.FEB.2012 15:46:08

**Table 1: Loss Budget Table for 97.3 MHz.**

**System Gains and Losses for  
Fort Wayne, IN.**

ERI Job 28677

<b>Station Call Sign</b>	<b>WMEE</b>	
<b>Frequency (MHz)</b>	<b>97.3</b>	
	<b>Analog</b>	<b>Digital</b>
<b>ERP (W)</b>	<b>26000</b>	<b>0</b>
<b>Antenna Model</b>	<b>SHPXA-4AC-SP</b>	
<b>Antenna Gain (multiplier)</b>	<b>2.114</b>	<b>0</b>
<b>Antenna input power (W)</b>	<b>12299</b>	<b>0</b>
<b>Main Horizontal and Vertical Line</b>		
Line Length (feet)	614	0
Line loss per hundred feet (dB/100')	-0.0890	0.0000
Line loss total (dB)	-0.5465	0.0000
<b>Analog to Digital Isolation base of feedlines (dB)</b>	0	
<b>Analog to Digital Isolation at Antenna Input (dB)</b>	0.00	
<b>Analog to Digital Coupling Loss (dB)</b>	0.0000	
<b>Power Into Base of Vertical Line Run (W)</b>	<b>13948</b>	<b>0</b>
<b>Coupled Power at Filter Output Ports (W)</b>	<b>0</b>	<b>0</b>
<b>Filter Insertion Loss (dB)</b>	<b>-0.162</b>	<b>0.000</b>
<b>Power Input to Filter (W)</b>	<b>14478</b>	<b>0</b>
<b>Circulator Insertion Loss (dB)</b>	<b>0</b>	<b>0</b>
<b>Digital Power Input to Circulator</b>	<b>NA</b>	<b>0</b>
<b>Rigid Line</b>	<b>ERI Rigid</b>	<b>NA</b>
Line Length (feet)	100.5	0
Line loss per hundred feet (dB/100')	-0.095	0.000
Line loss total (dB)	-0.0955	0.000
<b>TPO (W)</b>	<b>14800</b>	<b>0</b>

**Table 2: Loss Budget Table for 105.1 MHz.**

**System Gains and Losses for  
Fort Wayne, IN.**

ERI Job 28677

<b>Station Call Sign</b>	<b>WQHK-FM</b>	
<b>Frequency (MHz)</b>	<b>105.1</b>	
	<b>Analog</b>	<b>Digital</b>
<b>ERP (W)</b>	<b>5700</b>	<b>0</b>
<b>Antenna Model</b>	<b>SHPXA-4AC-SP</b>	
<b>Antenna Gain (multiplier)</b>	<b>2.051</b>	<b>0</b>
<b>Antenna input power (W)</b>	<b>2779</b>	<b>0</b>
<b>Main Horizontal and Vertical Line</b>		
Line Length (feet)	614	0
Line loss per hundred feet (dB/100')	-0.0925	0.0000
Line loss total (dB)	-0.5680	0.0000
<b>Analog to Digital Isolation base of feedlines (dB)</b>	<b>0</b>	
<b>Analog to Digital Isolation at Antenna Input (dB)</b>	<b>0.00</b>	
<b>Analog to Digital Coupling Loss (dB)</b>	<b>0.0000</b>	
<b>Power Into Base of Vertical Line Run (W)</b>	<b>3167</b>	<b>0</b>
<b>Coupled Power at Filter Output Ports (W)</b>	<b>0</b>	<b>0</b>
<b>Filter Insertion Loss (dB)</b>	<b>-0.309</b>	<b>0.000</b>
<b>Power Input to Filter (W)</b>	<b>3401</b>	<b>0</b>
<b>Circulator Insertion Loss (dB)</b>	<b>0</b>	<b>0</b>
<b>Digital Power Input to Circulator</b>	<b>NA</b>	<b>0</b>
<b>Rigid Line</b>	<b>ERI Macxline 350A</b>	<b>NA</b>
Line Length (feet)	115.5	0
Line loss per hundred feet (dB/100')	-0.099	0.000
Line loss total (dB)	-0.1143	0.000
<b>TPO (W)</b>	<b>3492</b>	<b>0</b>