# Antenna System Field Service Report

**Cumulus Broadcasting, Inc.**

**WKMQ-FM**
**96.7 Mhz**
**Loves Park, IL**

Antenna Model- DCR-H-2E-5RE
Transmission Line- Andrew HJ7 1-5/8" x 425'

*prepared for:*

**Dielectric Communications, Inc.**
**MSO # 71440**

**D.L. Markley & Associates, Inc.**
2104 West Moss Avenue
Peoria, Illinois 61604
(309)673-7511



**Exhibit E, Figure 1**

## Antenna System Field Report

This report has been prepared for Dielectric Communications and contains tests and measurements performed at the Cumulus Broadcasting station WKMQ-FM located near Rockford, IL. The attached data plots were taken on April 3, 2002 between the hours of 5:00 and 6:30 PM.

The test equipment utilized for this report was a Hewlett-Packard 8753 E Network Analyzer. This instrument was calibrated on-site for the frequency specific to WKMQ and in accordance with the manufacturer's instructions. The ISO 9002 calibration certificate for this Analyzer is on file with Dielectric Communications. To ensure maximum accuracy and data plot clarity the test instrument was set to the 1601 point mode and the generator was set to +20 dbm to overcome incoming signals from the existing WKMQ site.

WKQM was relocating to a new tower site. They purchased a new Dielectric DCR-H directional antenna and new Andrew Corp. HJ-7 transmission line. The antenna installation was looked over from the ground with binoculars and compared with the factory installation drawings. Attached at the end of the report is a Directional Antenna Installation Affidavit to confirm that the antenna was installed in accordance with the factory drawings. Connection to the 1-5/8" transmission line for the system measurements was made with a test transition provided by this office.

The data plots in this report were taken under two conditions. Plots #1-#10 show the antenna initial readings with the fine-matcher plungers pulled out. Plots #11-#21 are the final measurements performed after coordinating tuning of the antenna fine-matcher with the assistance of personnel on the tower. The next section provides a discussion of each data plot.

## Discussion of Individual Plots

The 1st Plot is an initial measurement of the antenna system VSWR in the Frequency Domain with a 10 Mhz pulse span. Marker One was placed on the center of the stations carrier and had a value of 1.231. Marker Two was set 100 Khz below the carrier and had a reading of 1.231. Marker Three was placed 100 Khz above the center carrier and had a VSWR of 1.263.

Plot #2 is a Log Magnitude measurement in the Frequency Domain. Marker was placed at 96.7 Mhz and had a Return Loss reading of 19.6 db. The Second Marker was set to 96.6 Mhz had a value of 20.9 db. Marker Three was located on 96.8 Mhz and had a reading of 18.6 db.

The 3rd Plot is a Smith Impedance Chart with a 10 Mhz span. Marker One detailed the center of carrier initial impedance with a measurement of 56.8 +j 9.2 Ω. The Second Marker was located 100 Khz below Marker One and had a value of 50.0 +j 9.0 Ω. Marker Three detailed the impedance 100 Khz above Marker One and had a reading of 62.7 +j 3.07 Ω.

Plots #4 and #5 are Time Domain measurements with a 10 Mhz pulse width. Marker One was set at the antenna-end of the system and had an average VSWR of 1.27, which was a reflection of 11.9%. The Second Marker was placed approximately 350' from the test connection and had a value of 1.006. Marker Three was set near the 10' point of the system and had a VSWR of 1.01.

Plot #6 is a Frequency Domain measurement in the VSWR mode with a 1 Mhz span for a closer view of the antenna system's initial response. Marker One was set to 96.7 Mhz and had a VSWR of 1.213. The Second Marker was placed 100 Khz below the center frequency and had a reading of 1.197. Marker Three detailed the initial VSWR 100 Khz above the station's frequency, and had a value of 1.26.

Plot #7 is a Log Magnitude measurement in the Frequency Domain. The Markers are placed as in Plot #6 and showed readings of 19.93 db, 20.91 db and 18.67 db respectively.

Plot #8 is a Smith Impedance Chart over a 1 Mhz span. Marker One showed the initial impedance at the center carrier to be 56.67 +j 8.7 Ω. The Second Marker was placed on 96.6 Mhz and had an initial reading of 49.94 +j 9.0 Ω. Marker Three detailed the initial impedance 100 Khz above the center frequency and had a value of 62.7 +j 3.15Ω.

Plots #9 and #10 are Time Domain measurements with a 1 Mhz pulse width. Marker One was set near the antenna input and had an average VSWR of 1.22, which had a reflection 10 %. as shown in Plot #10. The Second Marker was placed approximately 200' from the test connection and had a value of 1.17. Marker Three was located near the tower base and showed a reading of 1.11.

The 11$^{th}$ Plot is the first of eleven final measurements performed after adjusting the antenna's input fine-matcher. Marker One was set to 96.7 Mhz and had a final reading of 1.033. The Second Marker was placed 100 Khz below Marker One and had a value of 1.033. The Third Marker was set 100 Khz above Marker One and had a VSWR of 1.044.

Plot #12 is a Log Magnitude measurement in the Frequency Domain with a 10 Mhz pulse span. The Markers are set as in Plot #11 and showed final Return Loss readings of 34.94 db, 35.7 db and 33.1 db respectively.

The 13$^{th}$ Plot is a Smith Impedance Chart over a 10 Mhz pulse span. Marker One, at the station's carrier, had a final impedance of 49.98 +j 1.41 Ω. The Second Marker was placed on 96.6 Mhz and had a reading of 48.4 +j 0.2 Ω. Marker Three detailed the impedance at 96.8 Mhz to have been 52.09 + 0.7 Ω.

Plots #14 and #15 are Time Domain measurements of the antenna system. Marker One was set at the antenna-end of the system and had an average VSWR of 1.22 over the 10 Mhz pulse width. Marker Two was placed approximately 339' from the test transition and had a reading of 1.003, which was a reflection of .1% as shown in Plot 15. The Third Marker was located near the tower base and had a value of 1.01, which was a reflection of .5%.

The next four plots are measurements with a 1 Mhz pulse width for closer clarification of the antenna system after being tuned. Plot #16 is a VSWR measurement in the Frequency Domain. Marker One was set to the station's carrier and had a final VSWR of 1.03. Marker Two was placed 100 Khz below the center frequency and had a reading of 1.033. The Third Marker was set 100 Khz above the carrier and had a value of 1.044.

The 17$^{th}$ Plot is a Log Magnitude measurement in the Frequency Domain. The markers were placed as in Plot #16 and had readings of 36.4 db, 35.8 db, and 33.1 db respectively.

Plot #18 is a Smith Impedance Chart with a 1 Mhz pulse span. The relative shape of the chart shows the antenna system to be very well centered on the chart with the upper and lower frequencies circling around the center point, which is the optimum placement for a properly tuned system. Marker One had a final impedance of 50.1 +j 1.3 Ω. The Second Marker was set to 96.6 Mhz and had a reading of 48.3 +j 0.17 Ω. The Third Marker was located on 96.8 Mhz and had a value of 51.9 +j 0.6 Ω.

The next data plot, #19, is a Time Domain measurement. Marker One was placed near the antenna input and had a VSWR reading of 1.02. Marker Two was set approximately 212' from the test connection and had a reading of 1.004. Marker Three was placed near the tower base and had a value of 1.01.

The final two data plots, #20 and #21, are Time Domain measurements with a 100 Mhz pulse width to check over the transmission line run. Marker One was set at the top of the line run and had a VSWR reading of 1.002, which was a reflection of .1% as shown in Plot #21. Marker Two was set in the line vertical run and had a reading of 1.0008. The Third Marker was placed 34' feet from the test connection and had a VSWR of 1.0027, which was a reflection of .1% as shown in Plot #21. The Fourth Marker was located near the test connection and had a reading of 1.007.

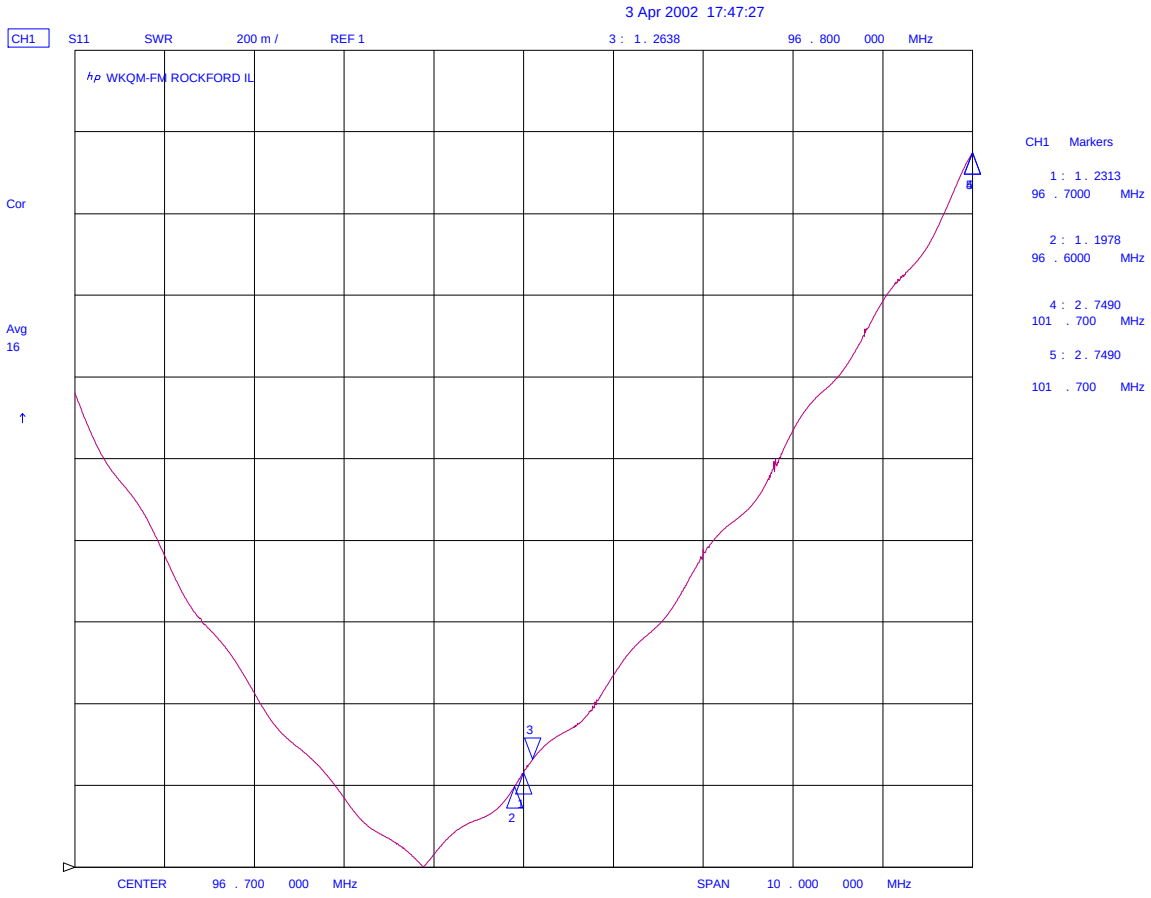
## Conclusion

By the tests and measurements performed on the WKMQ-FM antenna system it appeared to be well below the typical VSWR specification of 1.1 to 1. At the carrier frequency the transmission line and antenna showed a combined VSWR of 1.03 and plus or minus 100 Khz of the carrier center the VSWR was 1.04 and 1.03 respectively. The proceedings described in this report were witnessed by the station's Chief Engineer, Joe McCall, and met with his approval.

This report has been prepared by myself or under my direction and is true and accurate to the best of my belief and knowledge.

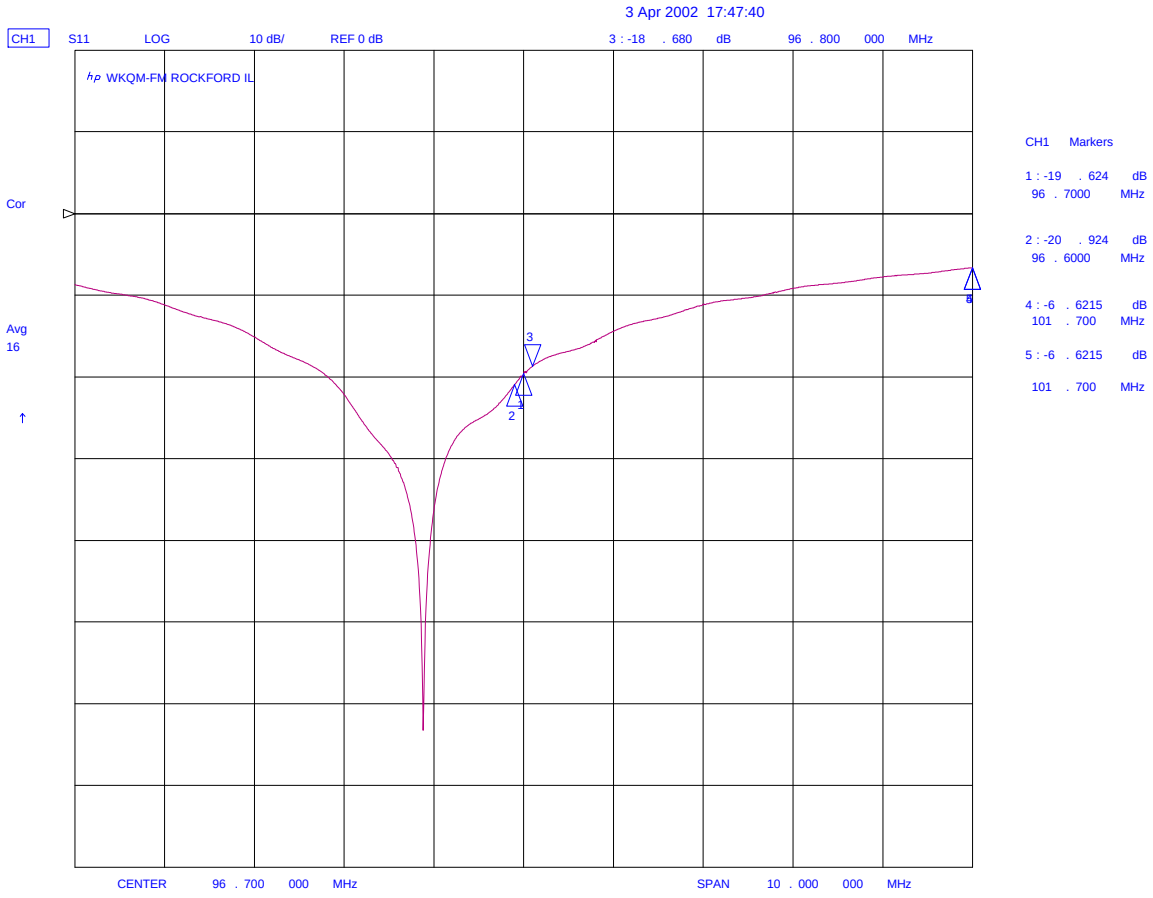
*Richard Wood*
Staff Engineer
D.L. Markley and Associates, Inc.
April 5, 2002

# WKMQ-FM Antenna System



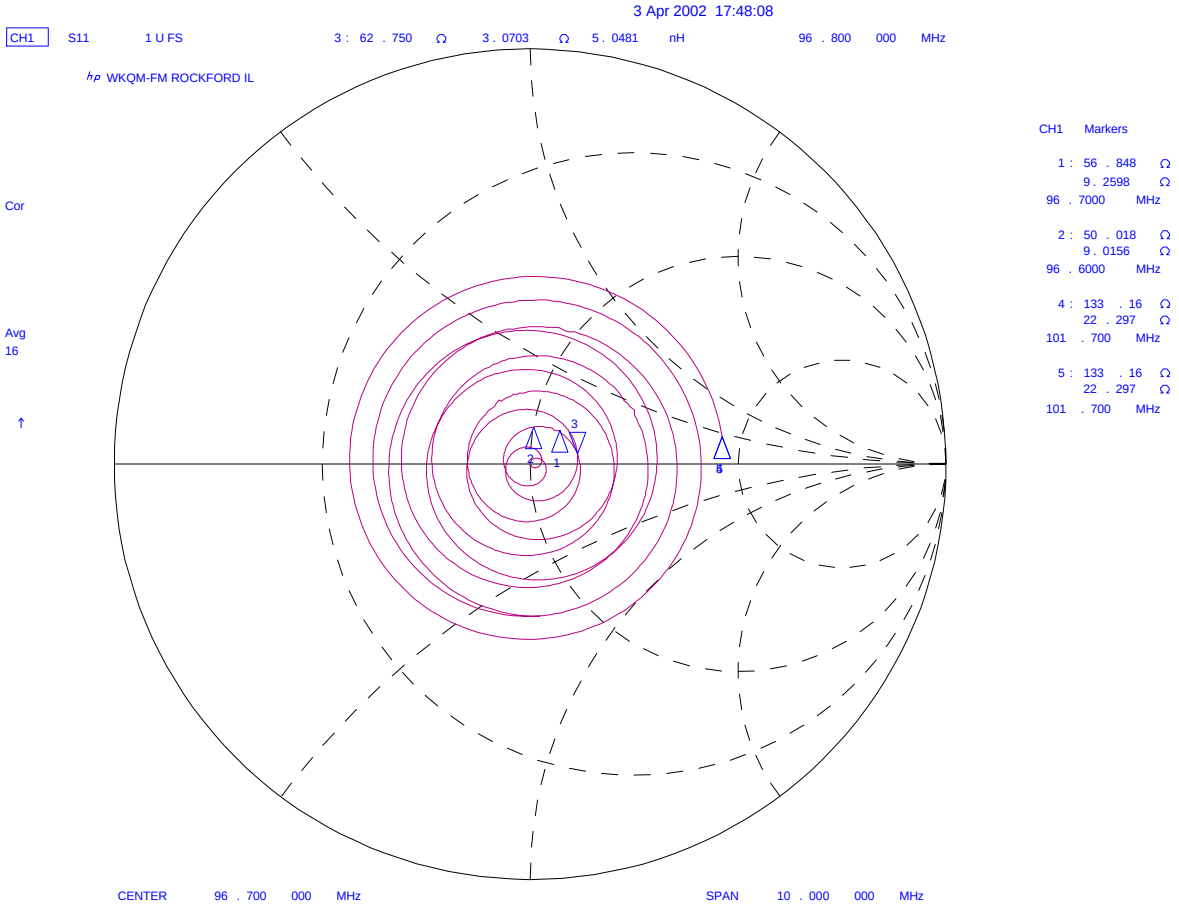

**Plot #1 Initial Frequency Domain VSWR**
**10 Mhz Pulse**

# WKMQ-FM Antenna System



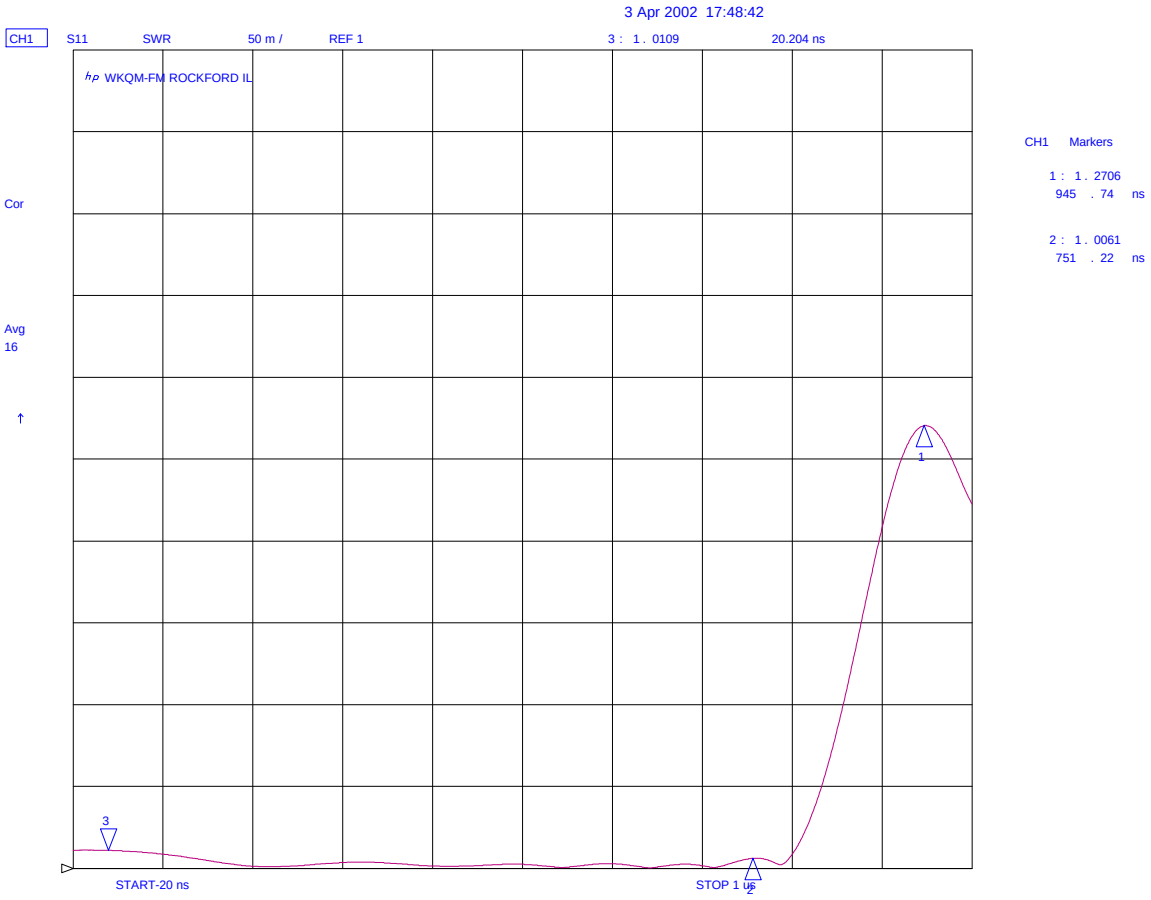

## Plot #2 Initial Frequency Domain Log Magnitude
## 10 Mhz Pulse

# WKMQ-FM Antenna System



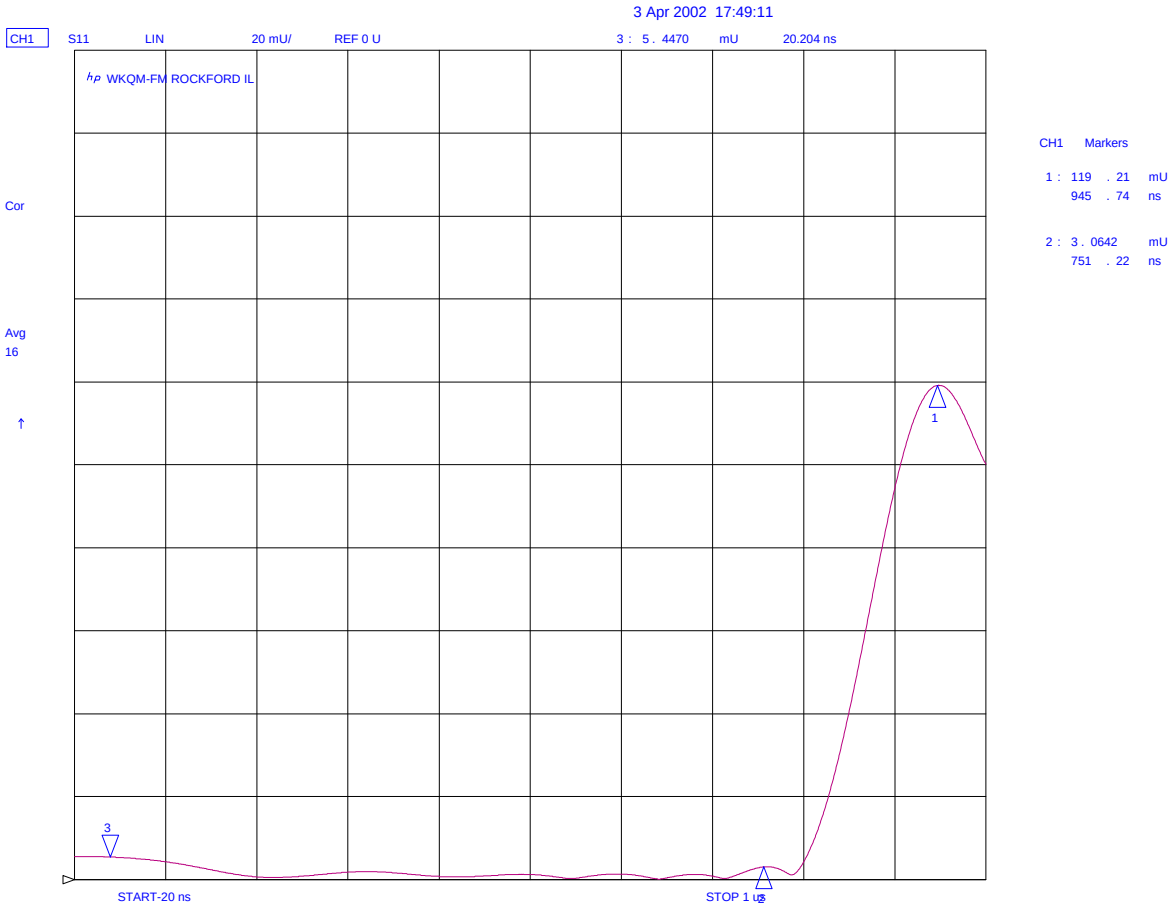

## Plot #3 Initial Frequency Domain Smith Chart
## 10 Mhz Pulse

# WKMQ-FM Antenna System



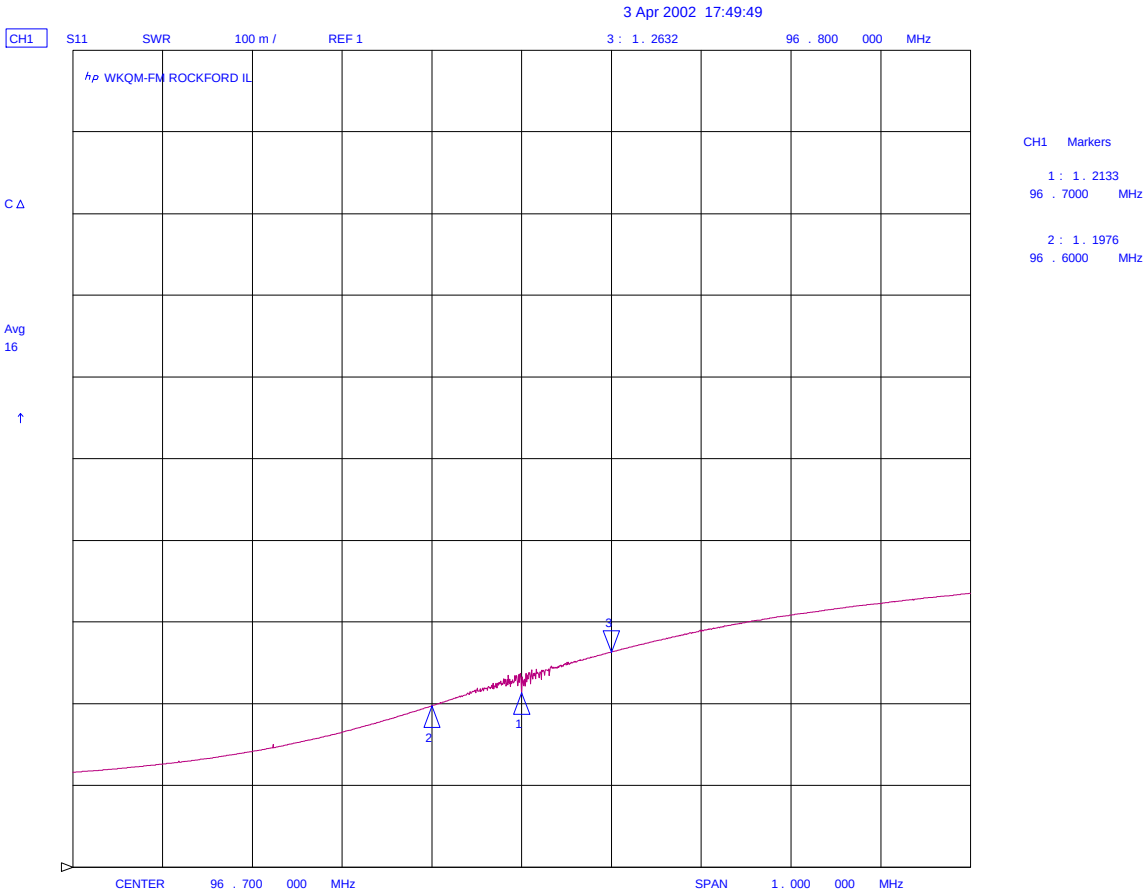

## Plot #4 Initial Time Domain VSWR
## 10 Mhz Pulse

# WKMQ-FM Antenna System



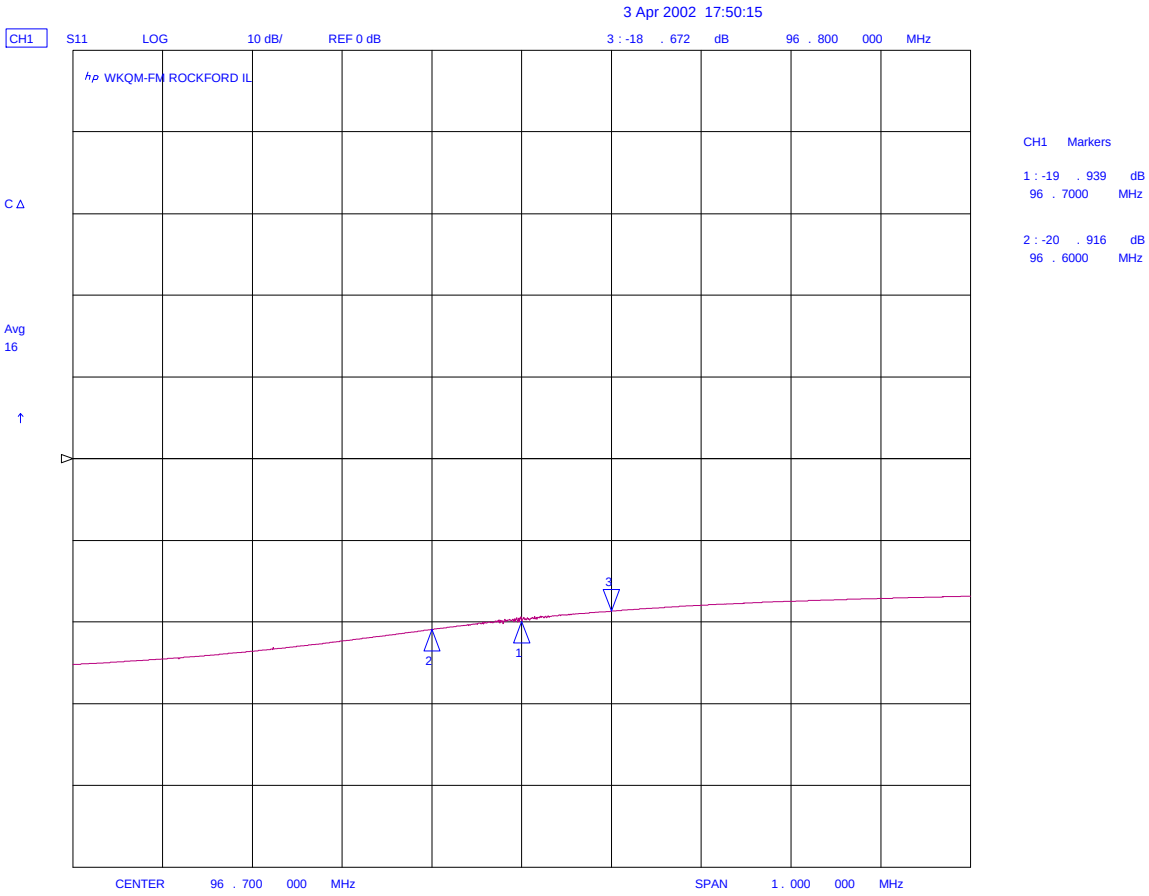

## Plot #5 Initial Time Domain Linear Magnitude
## 10 Mhz Pulse

# WKMQ-FM Antenna System



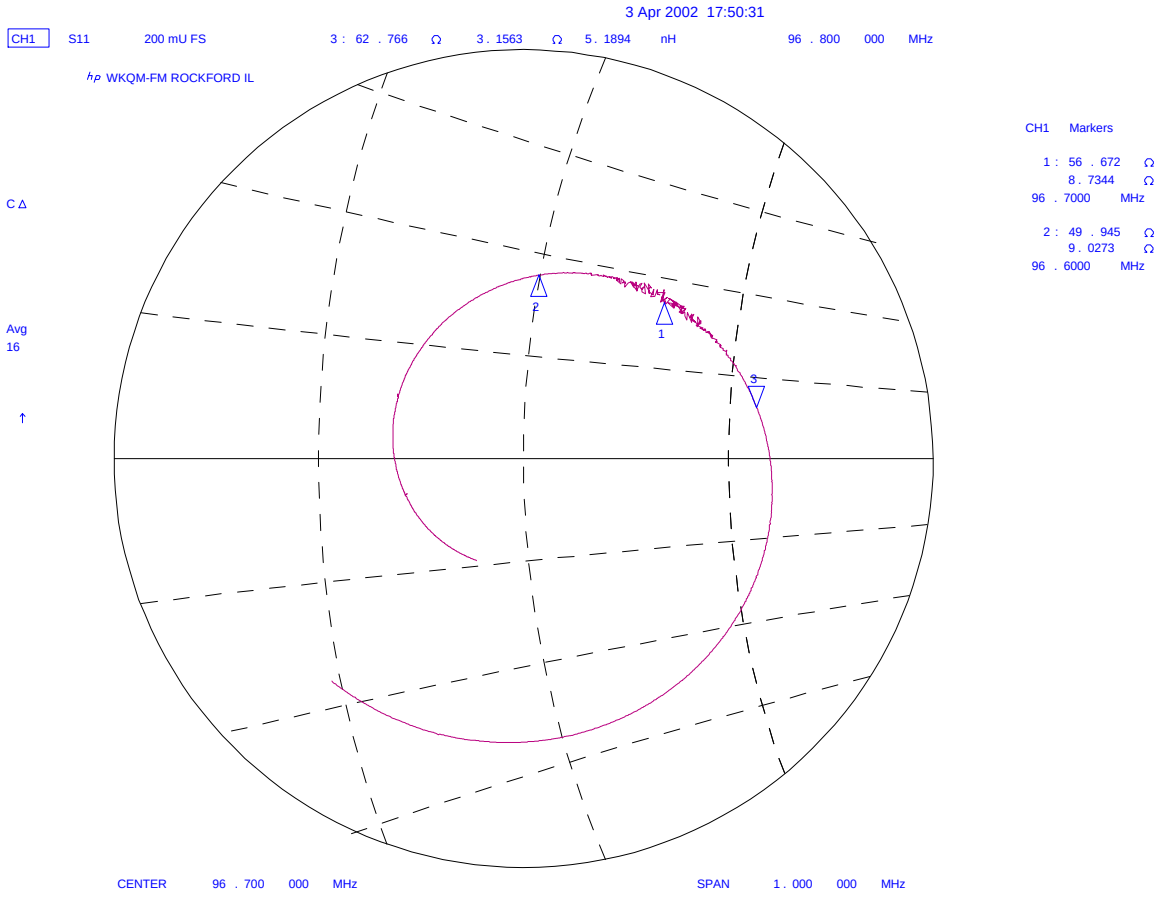

## Plot #6 Initial Frequency Domain VSWR
## 1 Mhz Pulse

# WKMQ-FM Antenna System



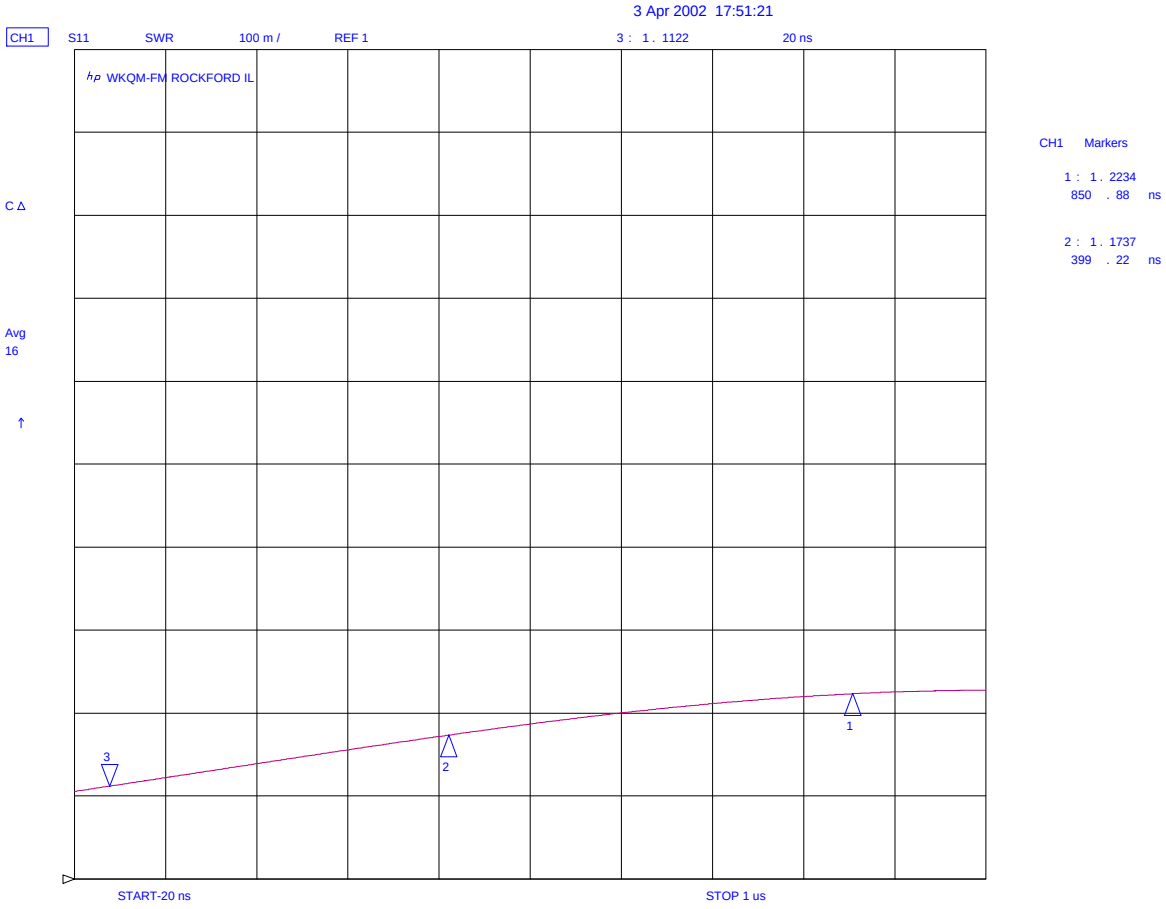

## Plot #7 Initial Frequency Domain Log Magnitude
## 1 Mhz Pulse

# WKMQ-FM Antenna System



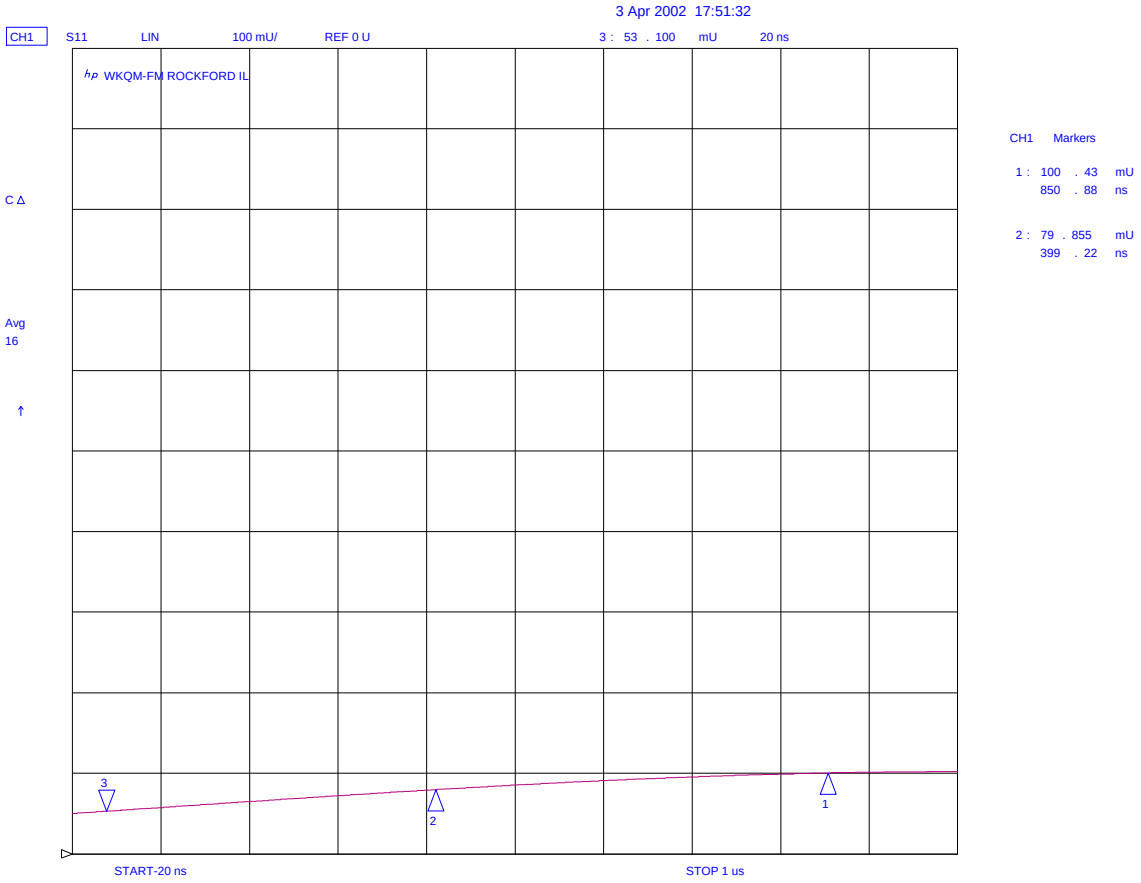

## Plot #8 Initial Frequency Domain Smith Chart
## 1 Mhz Pulse

# WKMQ-FM Antenna System



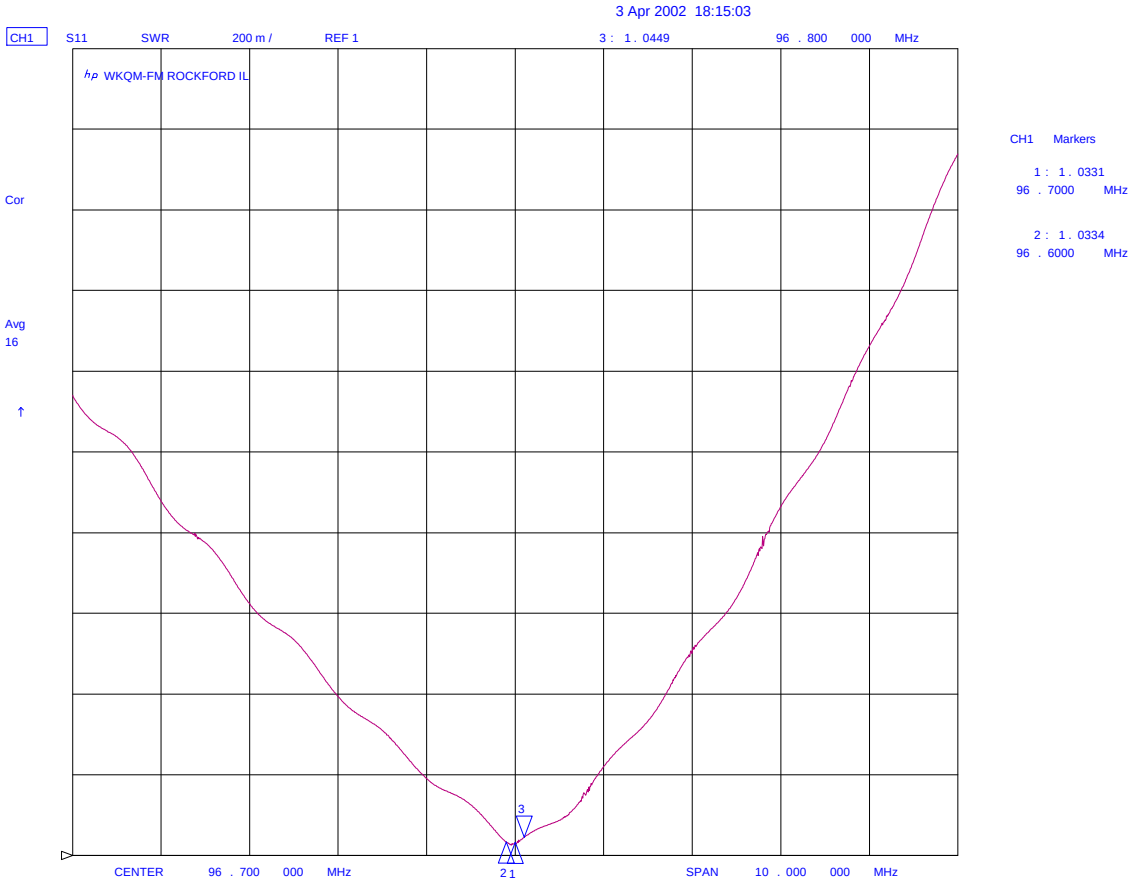

## Plot #9 Initial Time Domain VSWR
## 1 Mhz Pulse

# WKMQ-FM Antenna System



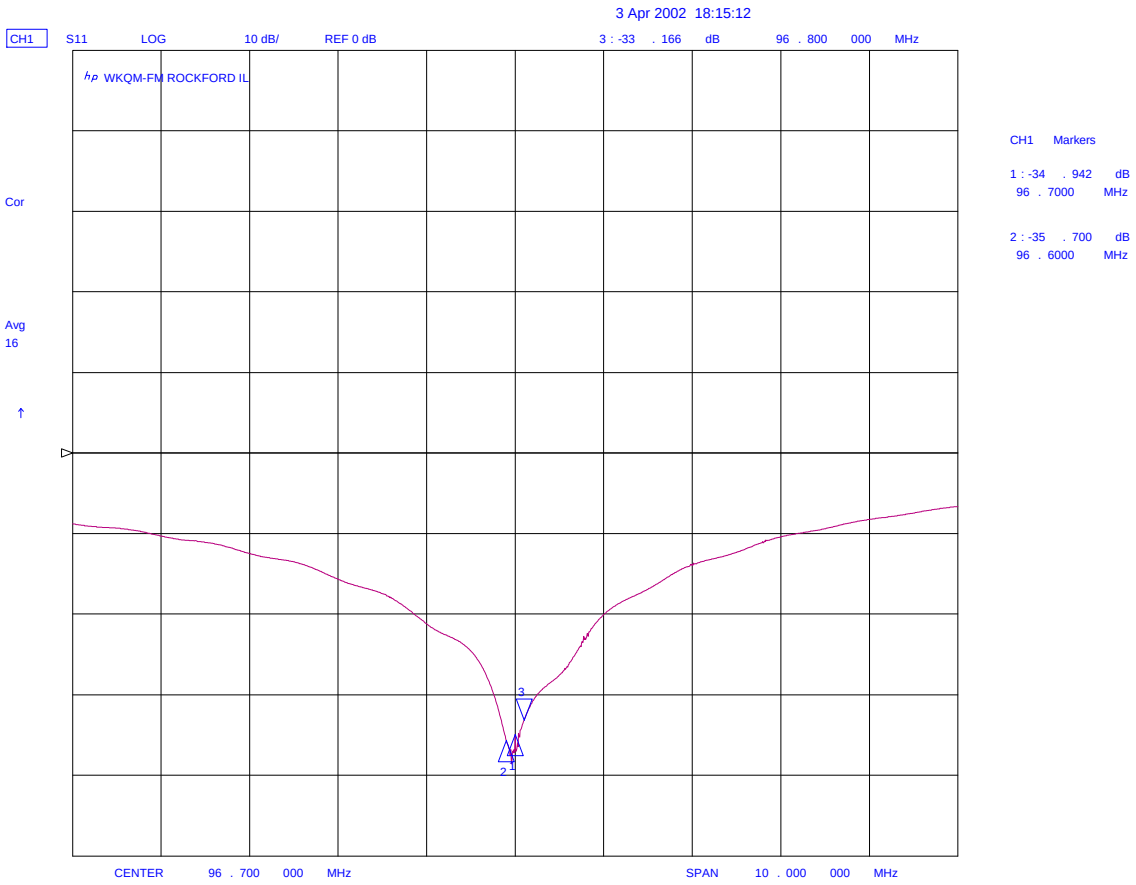

## Plot #10 Initial Time Domain Linear Magnitude
## 1 Mhz Pulse

# WKMQ-FM Antenna System



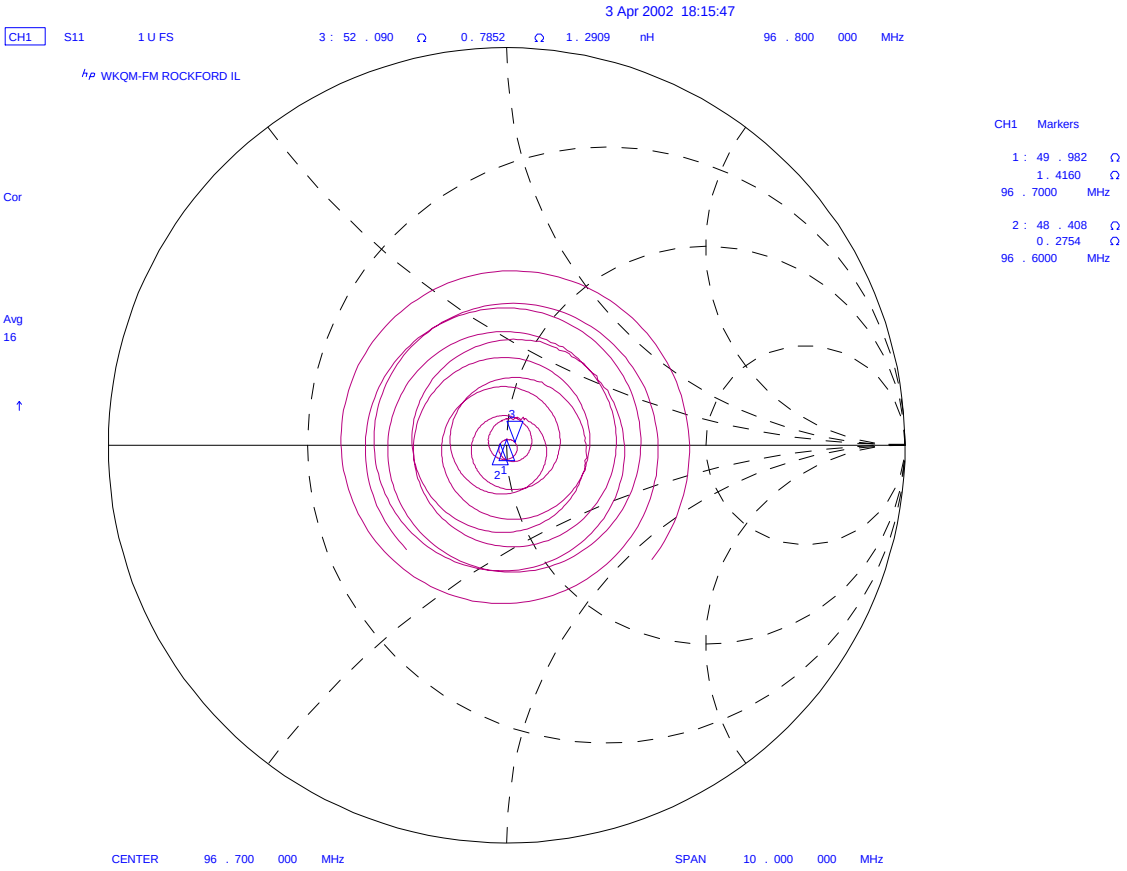

## Plot #11 Final Frequency Domain VSWR
## 10 Mhz Pulse

# WKMQ-FM Antenna System



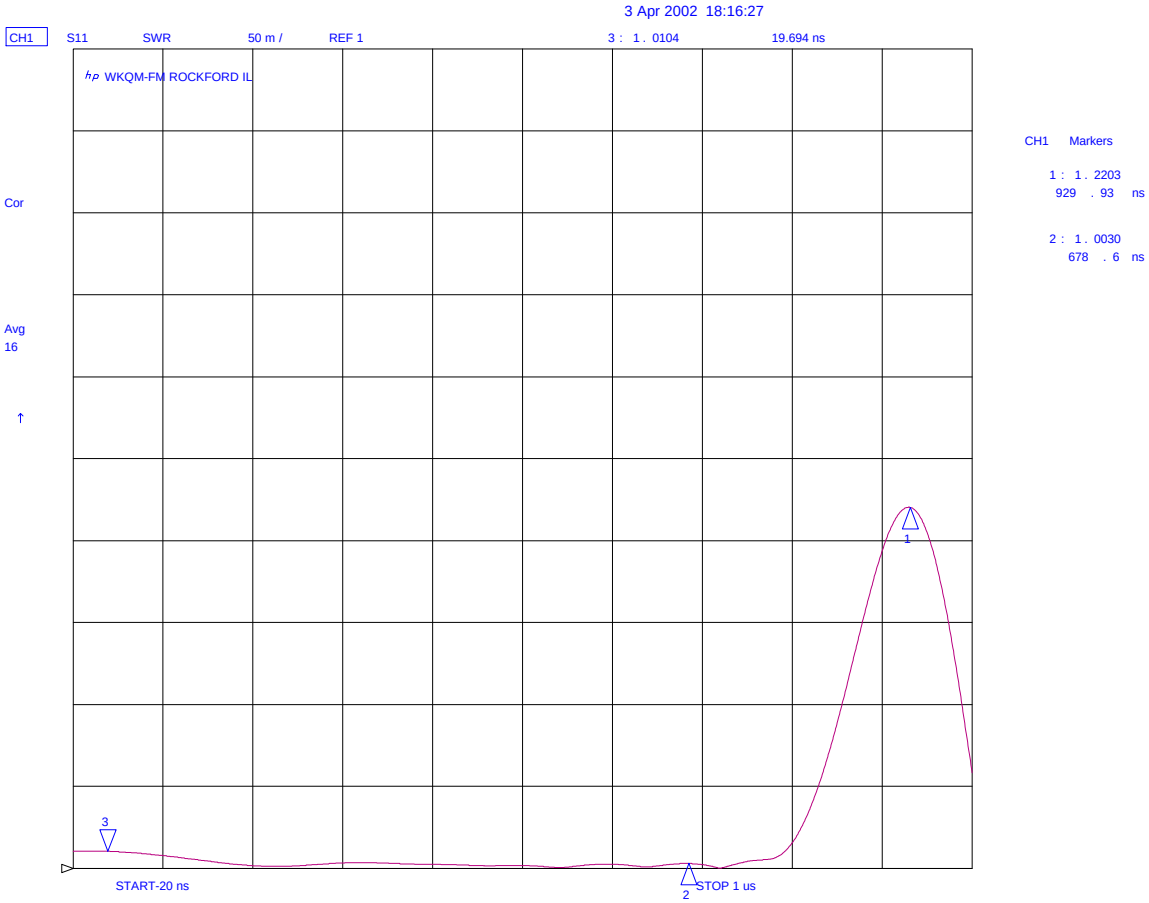

**Plot #12 Final Frequency Domain Log Magnitude**
**10 Mhz Pulse**

# WKMQ-FM Antenna System



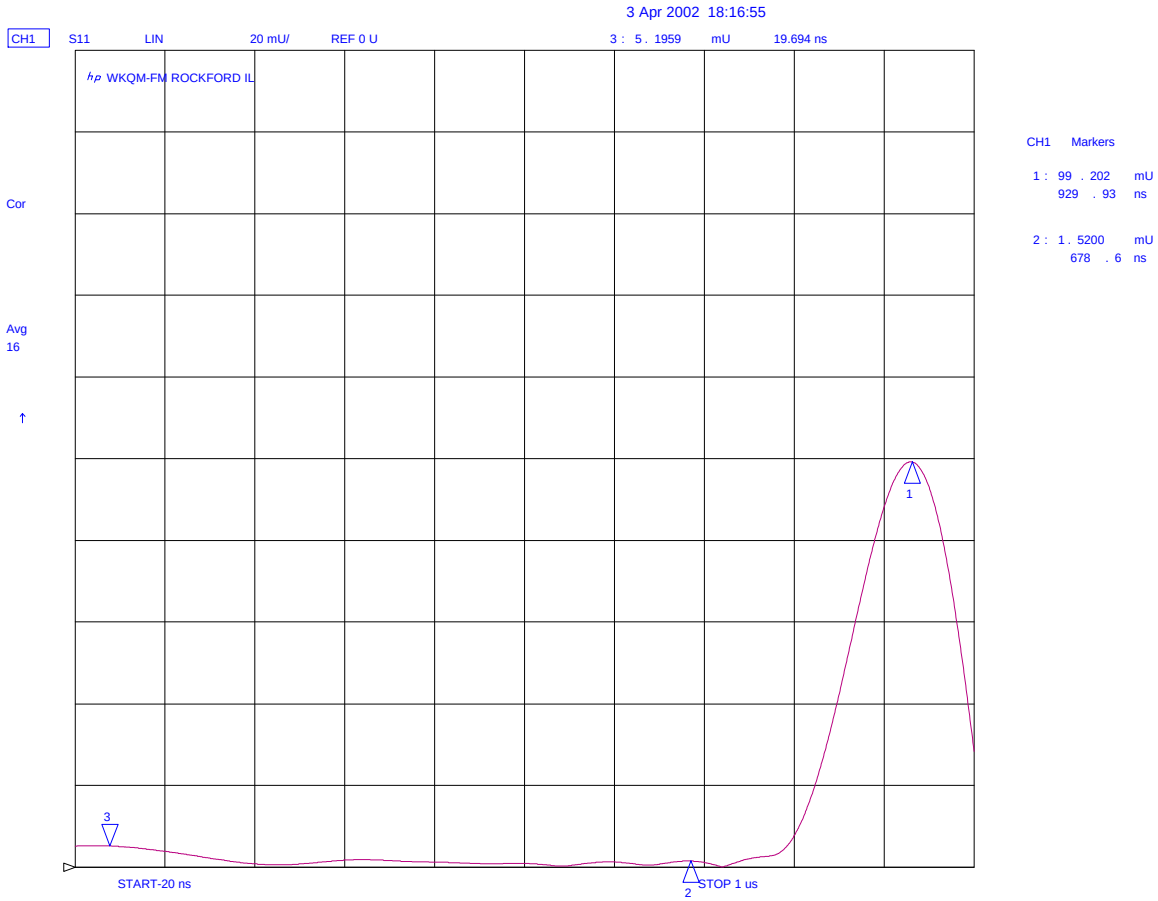

## Plot #13 Final Frequency Domain Smith Chart
## 10 Mhz Pulse

# WKMQ-FM Antenna System



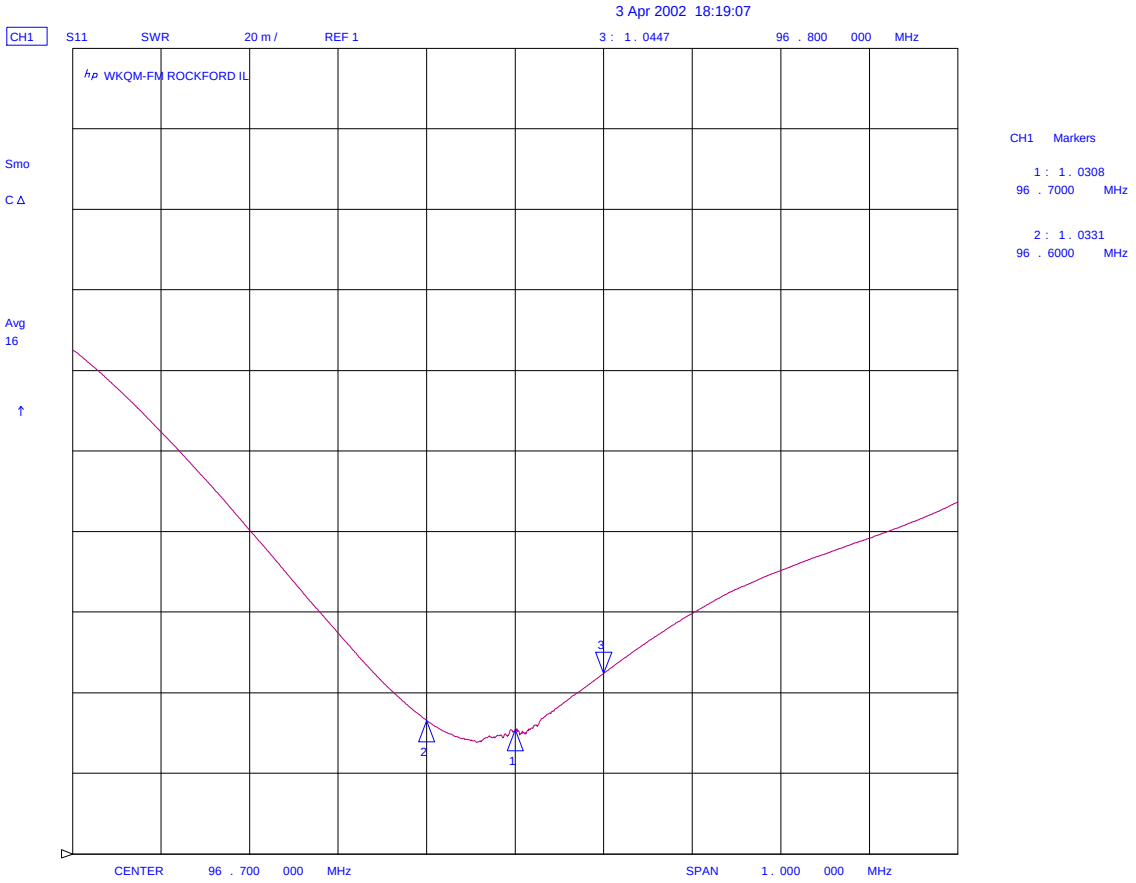

## Plot #14 Final Time Domain VSWR
## 10 Mhz Pulse

# WKMQ-FM Antenna System



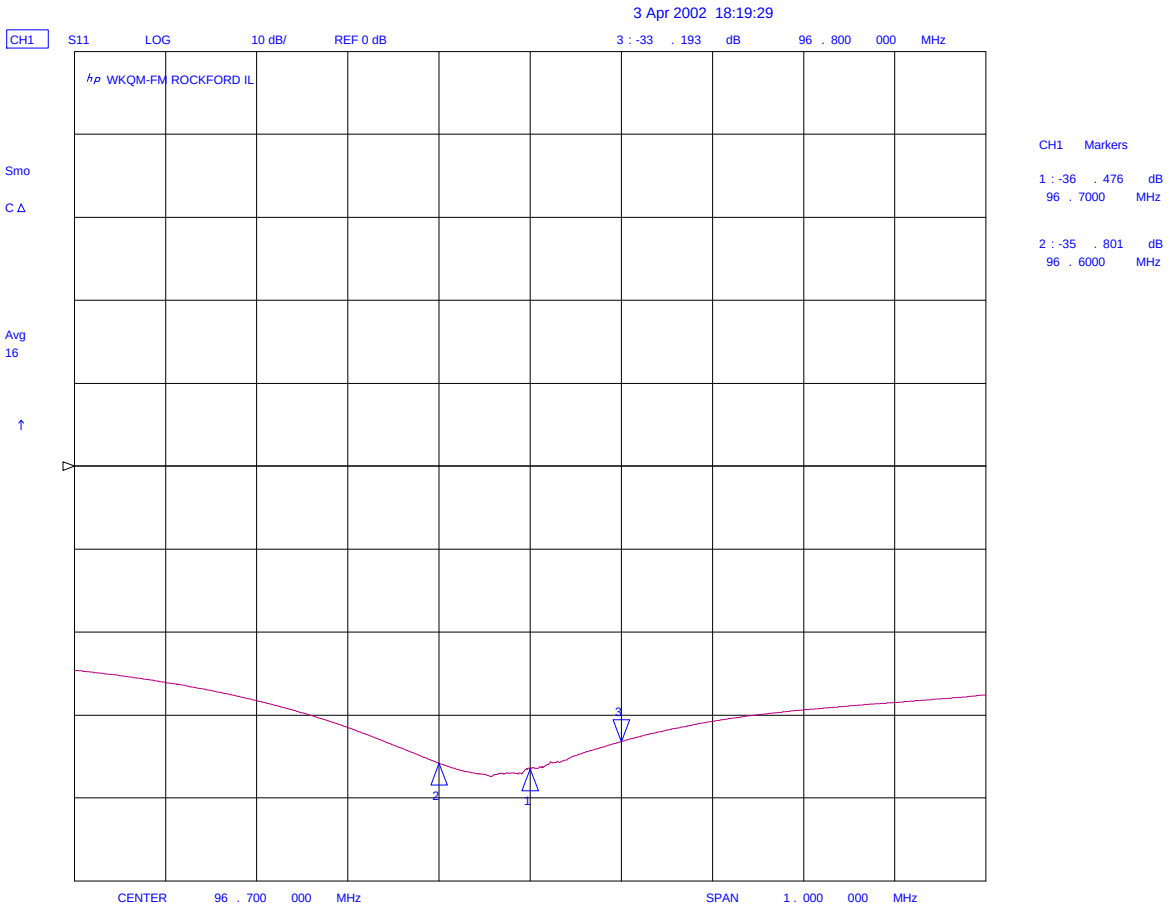

## Plot #15 Final Time Domain Linear Magnitude
## 10 Mhz Pulse

# WKMQ-FM Antenna System



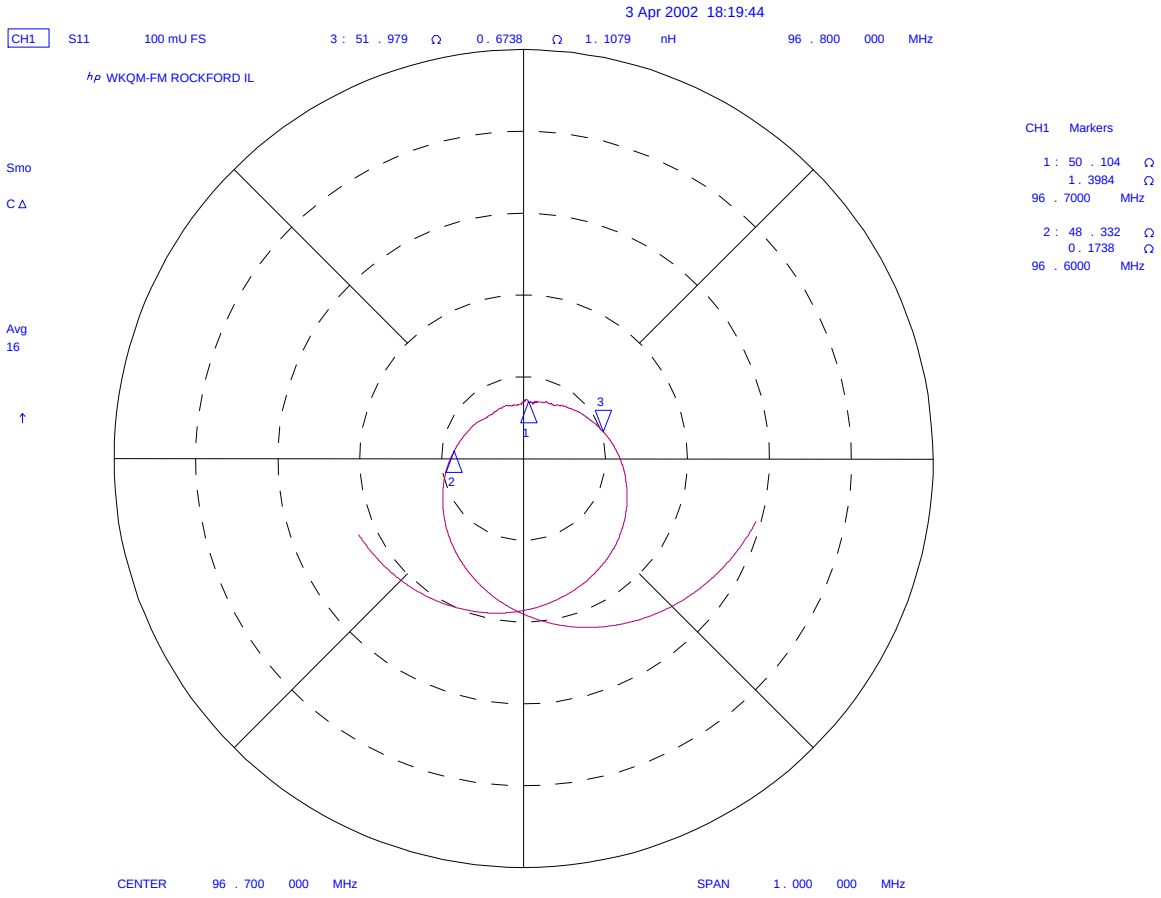

## Plot #16 Final Frequency Domain VSWR
## 1 Mhz Pulse

# WKMQ-FM Antenna System



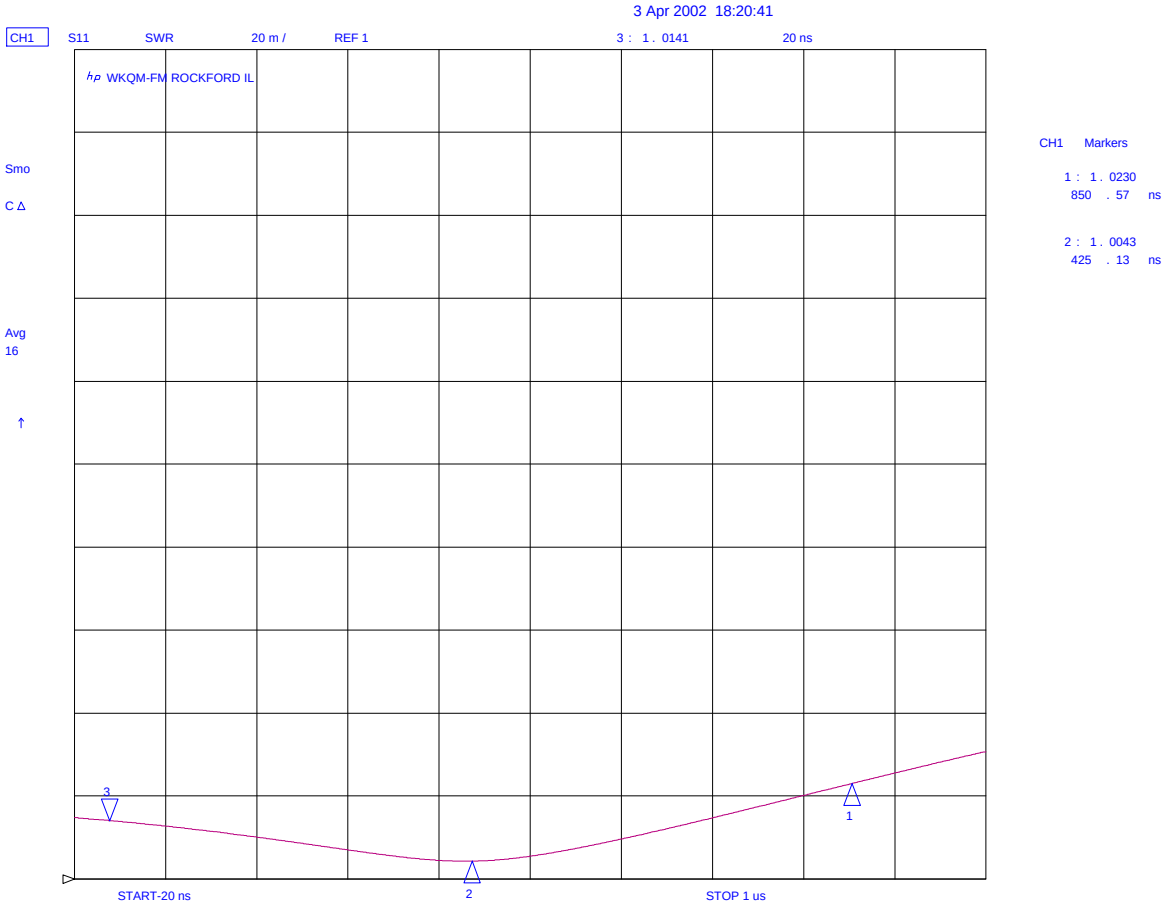

**Plot #17 Final Frequency Domain Log Magnitude**
**1 Mhz Pulse**

# WKMQ-FM Antenna System



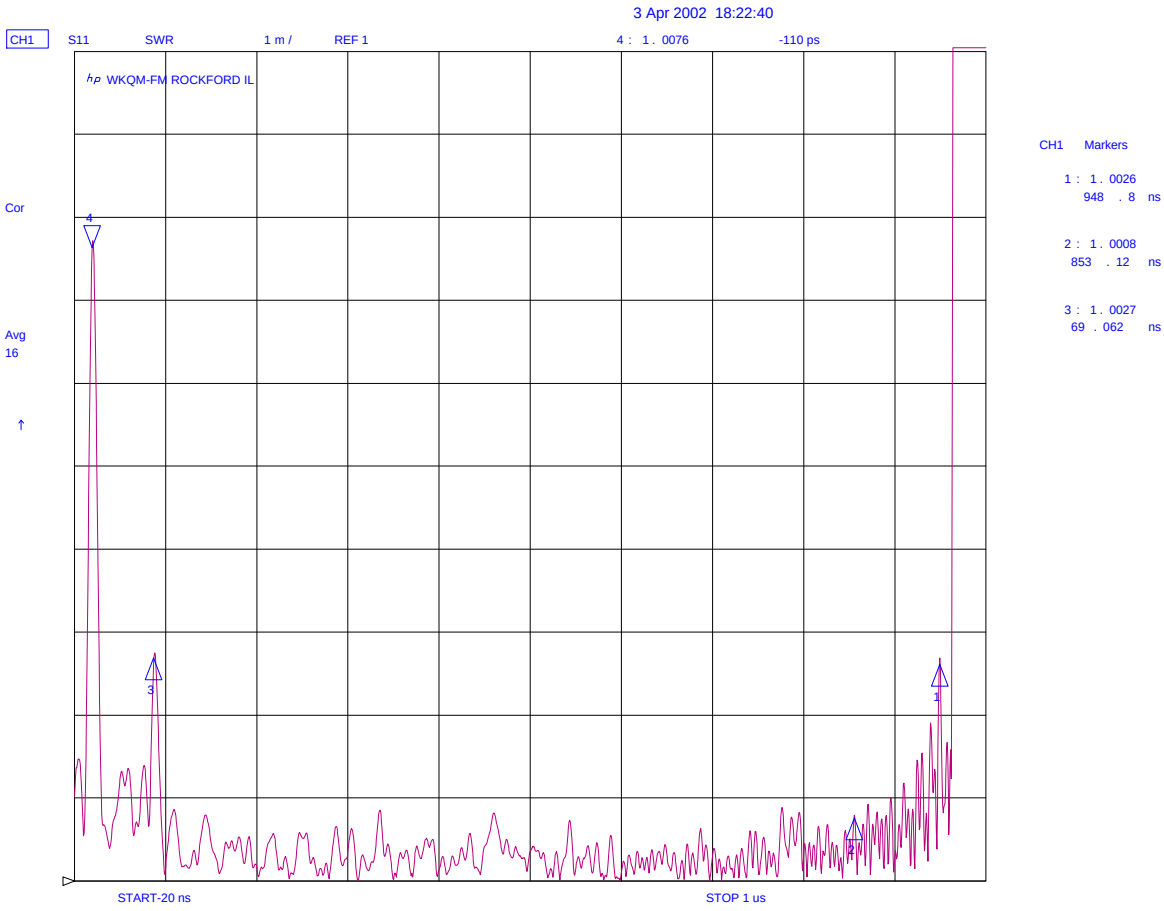

## Plot #18 Final Frequency Domain Smith Chart
## 1 Mhz Pulse

# WKMQ-FM Antenna System



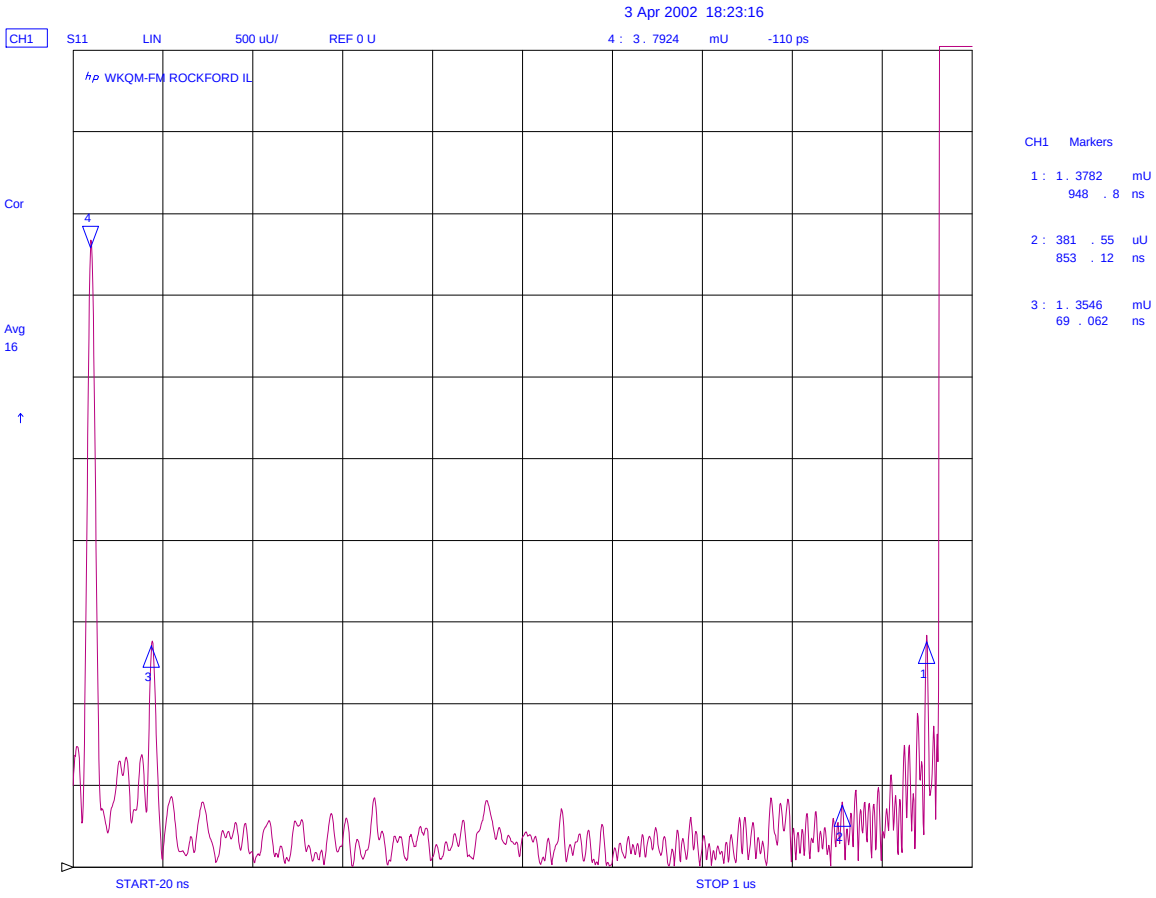

## Plot #19 Final Time Domain VSWR
## 1 Mhz Pulse

# WKMQ-FM Antenna System




## Plot #20 Final Time Domain VSWR
## 100 Mhz Pulse

# WKMQ-FM Antenna System




**Plot #21 Final Time Domain Linear Magnitude**
**100 Mhz Pulse**

**Summary of Antenna System Measurements**

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Station:** | **WKMQ Loves Park, IL** | | | **Channel:** | **244** | | | **Mode:** | **FM** | | |
| | **Carrier Frequencies** | **96.7 Mhz** | | | | | | | **Measurement Date** | | April,3 2002 | |
| Ex. | Measurement | Vertical | Marker 1 | | Marker 2 | | Marker 3 | | Marker 4 | | Marker 5 | |
| # | Description | Div. | Location | Value | Location | Value | Location | Value | Location | Value | Location | Value |
| | Initial Measurements Before Adjustments | | | | | | | | | | | |
| 1 | Frequency DomainVSWR(10Mhz) | 200m | 96.7Mhz | 1.231 | 96.6Mhz | 1.197 | 96.8Mhz | 1.263 | | | | |
| 2 | Frequency Domain Log Magnitude | 10db | 96.7Mhz | 19.6db | 96.6Mhz | 20.9db | 96.8Mhz | 18.6db | | | | |
| 3 | Frequency Domain Smith Chart | 1UFS | 96.7Mhz | 56.8+j9.2 | 96.6Mhz | 50.0+j9.0 | 96.8Mhz | 62.7+j3.07 | | | | |
| 4 | Time Domain VSWR (10 Mhz) | 50m | 945.74ns | 1.27 | 751.22ns | 1.006 | 20.2ns | 1.01 | | | | |
| 5 | Time Domain Linear Mag(10 Mhz) | 20mU | 945.74ns | 119.2mU | 751.22ns | 3.06mU | 20.2ns | 5.44mU | | | | |
| 6 | Frequency Domain VSWR (1Mhz) | 100m | 96.7Mhz | 1.213 | 96.6Mhz | 1.197 | 96.8Mhz | 1.26 | | | | |
| 7 | Frequency Domain Log Magnitude | 10db | 96.7Mhz | 19.93db | 96.6Mhz | 20.91db | 96.8Mhz | 18.67db | | | | |
| 8 | Frequency Domain Smith Chart | 200mU | 96.7Mhz | 56.67+j8.7 | 96.6Mhz | 49.94+j9.0 | 96.8Mhz | 62.7+j3.15 | | | | |
| 9 | Time Domain VSWR (1 Mhz) | 100m | 850.88ns | 1.22 | 399.22ns | 1.170 | 20ns | 1.11 | | | | |
| 10 | Time Domain Lin Mag (1 Mhz) | 100mU | 850.88ns | 100.4mU | 399.22ns | 79.85mU | 20ns | 53.1mU | | | | |
| | Final Measurements After Adjustment | | | | | | | | | | | |
| 11 | Frequency DomainVSWR(10Mhz) | 200m | 96.7Mhz | 1.033 | 96.6Mhz | 1.0330 | 96.8Mhz | 1.044 | | | | |
| 12 | Frequency Domain Log Magnitude | 10db | 96.7Mhz | 34.94db | 96.6Mhz | 35.7db | 96.8Mhz | 33.16db | | | | |
| 13 | Frequency Domain Smith Chart | 1UFS | 96.7Mhz | 49.98+j1.41 | 96.6Mhz | 48.4+j0.2 | 96.8Mhz | 52.09+j0.7 | | | | |
| 14 | Time Domain VSWR(10 Mhz) | 50m | 929.93ns | 1.22 | 678.6ns | 1.003 | 19.69ns | 1.01 | | | | |
| 15 | Time Domain Lin Mag (10 Mhz) | 20mU | 929.93ns | 99.2mU | 678.6ns | 1.52mU | 19.69ns | 5.19mU | | | | |
| 16 | Frequency Domain VSWR (1Mhz) | 20m | 96.7Mhz | 1.03 | 96.6Mhz | 1.033 | 96.8Mhz | 1.044 | | | | |
| 17 | Frequency Domain Log Magnitude | 10db | 96.7Mhz | 36.4db | 96.6Mhz | 35.8db | 96.8Mhz | 33.1db | | | | |
| 18 | Frequency Domain Smith Chart | 100mU | 96.7Mhz | 50.1+j1.3 | 96.6Mhz | 48.3+j0.17 | 96.8Mhz | 51.9+j0.6 | | | | |
| 19 | Time Domain VSWR (1 Mhz) | 20m | 850.57ns | 1.02 | 425.1ns | 1.004 | 20ns | 1.01 | | | | |
| 20 | Time Domain VSWR(100 Mhz) | 1m | 948.8ns | 1.002 | 853.12ns | 1.0008 | 69.06ns | 1.0027 | -110ps | 1.007 | | |
| 21 | Time Domain Lin Mag (100 Mhz) | 500uU | 948.8ns | 1.37mU | 853.12ns | 381.5uU | 69.06ns | 1.35mU | -110ps | 3.79mU | | |


**D.L. Markley & Associates, Inc.**
*Consulting Engineers*
2104 West Moss Avenue
Peoria, Illinois 61604
(309)673-7511

**D.L. Markley & Associates, Inc.**
**Consulting Engineers**
2104 West Moss
**Peoria, Illinois 61604**
**Member:** *AFCCE*
**Area Code 309**
**Telephone 673-7511**
**FAX 673-8128**

# Directional Antenna Installation Affidavit

**Station-WKMQ-FM**

**Frequency-96.7 Mhz**

**Channel- 244**

**Directional Antenna- Dielectric Inc. Model DCR-H-2E-5RE**

**Sirs:**

**I have inspected the Directional FM antenna installation for the above listed station and found it to be pursuant with the manufacture's instructions and installation drawings.**

**Richard Wood**
**FCC General Class Radio Telephone License # PG-18-28010**
**Staff Engineer**
**D.L. Markley & Associates, Inc.**
**April 4, 2002**